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The TRUTH about TESTING SAFES

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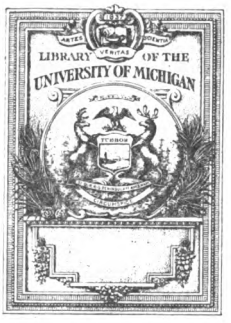

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"The Ponderous Door Opens" (P. 41)

Scene at Underwriters' Laboratories just before a safe is taken red hot from the furnace and dropped thirty feet.

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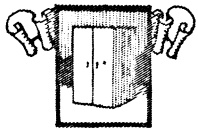

Prepared by the

BREARLEY SERVICE ORGANIZATION, NEW YORK

for the

NATIONAL ASSOCIATION *of*
STEEL FURNITURE MANUFACTURERS
CLEVELAND · OHIO

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AN APPRECIATION

W. H. MERRILL, PRESIDENT
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D. S. ANDERSON, SECRETARY
L. B. HEADEN, TREASURER

AGENCIES IN ALL PRINCIPAL CITIES OF THE UNITED STATES AND CANADA.

CHICAGO, 207 E. OHIO ST.
NEW YORK, 25 CITY HALL PLACE
BOSTON, 87 MILK ST.
PITTSBURGH, 324 FOURTH AVE.
SAN FRANCISCO, 205 MERCHANTS EXCHANGE BLDG.

Underwriters' Laboratories
INCORPORATED 1901
ESTABLISHED AND MAINTAINED BY THE
National Board of Fire Underwriters
FOR SERVICE - NOT PROFIT

Ref. No. Subj. L.S. 72 207 E. Ohio St. Chicago, December 12, 1922.

From: Vice President

To: National Association of Steel
Furniture Manufacturers,
Engineers Building,
Cleveland, Ohio.

Subject: Review of Manuscript.

1. As requested, our engineers have carefully reviewed the manuscript of your proposed book, "The Truth About Testing Safes". You have been notably successful, we feel, in describing with detailed accuracy, but in non-technical language, the routine test program regularly followed as a condition to our listing, classification and labeling safes. We are glad to note the emphasis given to our use of the American Standard Time Temperature Control Curve in the furnace work. This control curve is regularly used for all forms of fire retardants which we test and classify and has come to be truly a national or American Standard.

2. Was it necessary to feature our impartial status? We had supposed this self-evident in view of our organization, for service - not profit, and especially in view of our sponsorship - the 150 or more fire insurance company members of the National Board of Fire Underwriters. Generally speaking, fire insurance companies as well as property owners would lose whenever and wherever we failed to accomplish the object of our founders, which you quote: "To bring to the user the one best obtainable opinion as to the merits or demerits of appliances with respect to the fire hazard"

3. Without doubt the book will prove interesting as well as instructive to prospective purchasers of safes who are desirous of obtaining classified and certified protection. We congratulate you upon the accurate and effective way you have treated the subject.

A. R. Small

ARS:GM

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(*Including fac-simile reproductions of Factory Inspection Form and Official Notice of Defects.*)

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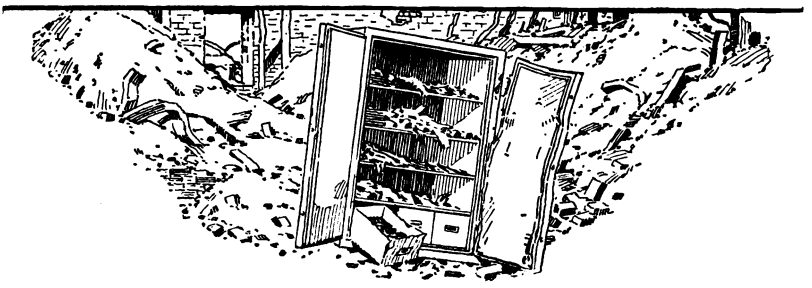
CHAPTER I

The Purchaser's Problem



THE most dangerous office marauder does not use burglars' tools.

Our forefathers had "strong boxes" designed with the single purpose of baffling thieves, but the average office safe today contains little to reward the labors of a hard-working burglar. The modern business man deposits his cash in the bank and his negotiable securities in a safety deposit box, yet he would not think of going for a single day without a safe. Why?—because his business welfare, perhaps his business existence, depends on the preservation of many vital documents and records—not from thieves but from *fire*.

Fire takes no account of values; it seeks combustibility. As long as paper is employed for records, so long will fire protection be the main motive in most purchases of safes. "Safe," therefore, means, or should mean, *fire safe*.

Unfortunately, all safes do not live up to their name. Times without number, owners have recovered their safes from the débris of ruined buildings only to find that

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the eagerly awaited contents were charred and worthless. Everyone knows of such instances, everyone wishes to avoid them in his own case. How may this be done?

This is the purchaser's problem.

Seeking Advice

The average man can form some idea of a house or an automobile by looking at it—not so with safes. A safe may be commodious and comely but these are minor points; the real question, *is it fire safe?* cannot be answered by the purchaser's eye. In the nature of the joints which can be judged by the expert alone, and, still more importantly, in the character of the insulation hidden within the metal walls, are to be found the true reasons why some safes are staunch protectors of their contents while others fail in an emergency.

No matter how much he may esteem his own opinions about most affairs, the average business man will admit that in the matter of safes he must take the word of someone else. Whose word shall he take?

The first salesman with whom he talks makes a wholehearted recommendation—of his own goods. A rival salesman, the next day, casts some doubt on the claims of the first and urges another make. It all is natural enough and the business man, who is used to the probably sincere partiality of salesmen, smiles at their enthusiasm but decides that he must find some other basis of judgment, some outside opinion that will be free from motives of self-interest.

It may be that he is furnished with the name of another purchaser by way of reference—but of what value is

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"Conferences Regarding Changes" (P. 63)

Before testing a new line of safes, it often happens that the Laboratories' engineers suggest needed improvements.

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such reference? Did the other purchaser get *his* opinion from the salesman, did he judge by appearances or has he actually had a fire? In this last event his opinion may have large value or it may have very little, for immediately there arises a new flock of questions, such as: How hot was the fire? How long did it last? What was the nature of the exposure? Did the safe suffer a fall? If so, how far? etc., etc.

It is unlikely that the other purchaser would be able to answer such questions with accuracy. To him in all probability the fire was just a fire, while the student of fires knows that they may differ quite as much as do persons or places.

Thus there are difficulties in the search for advice.

Tests and "Tests"

We are assuming a thorough type of business man who is properly careful about such a vital matter as the protection of his records. He has reached the obvious conclusion that even honest opinions are fallible. He sees that *fire alone can pass on fire protection and then only under known conditions.* Therefore he inquires about tests.

At this point it appears that manufacturers have already conceded the purchaser's right to assurance as to

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the qualities of their products. They tell him of various tests and he shows immediate interest but even yet is not too easily convinced. He knows that there are tests and "tests" and that it is perfectly feasible to go through a form of procedure whose results may be misleading. Therefore, before accepting the findings of any test he must ask two fundamental questions, viz:

1. Was it *impartial*?
2. Was it *thorough and adequate*?

This booklet purposes to discuss these two questions.

The Question of Impartiality

A miner was showing ore samples. "Here," said he," is a specimen running about ninety dollars to the ton and here is another that wouldn't assay at the rate of five dollars. I knocked both of them from the breast of the mine. They were about six inches apart.

"Now let me tell you something," he added earnestly—"if a miner is showing you ore, you can be sure that he isn't giving himself the worst of it. Of course, he will pick out the best specimens. *It is downright impossible for a man to be impartial about his own mine.*"

It can be taken as an axiom that impartiality—real impartiality—is as rare

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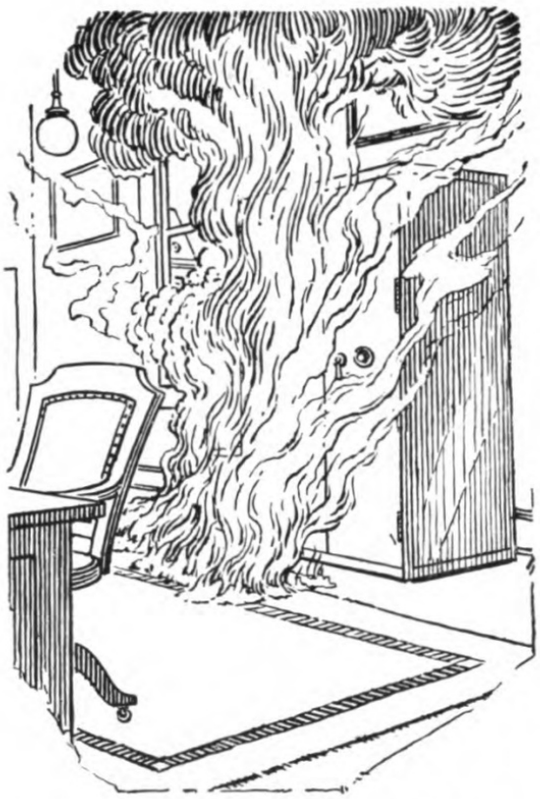

in other affairs as in mining. An absolutely impartial *self-test*, whether in safes or in soda water, implies a degree of self-abnegation that is well-nigh superhuman. Moreover, if a manufacturer's opinion of his own product is apt to reflect a personal bias, what shall be said of his statements in regard to his competitors?

The careful purchaser cannot do less than insist that the test upon which he buys his safe shall come from some source that lies outside of the industry and is of proved impartiality. There is only one source of this kind available in the case of safes; it is *Underwriters' Laboratories.*

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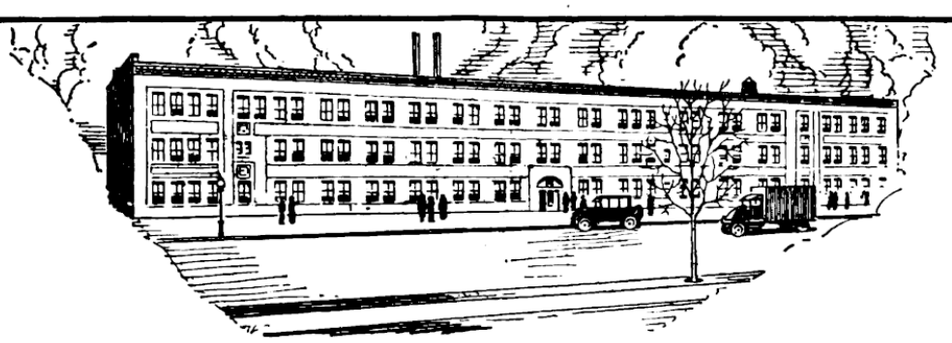
CHAPTER II

What is Underwriters' Laboratories?



SOMEONE has said: "This land of ours, in spite of the complexities of the things we possess and of the natural forces we use, is far safer to live in than it would be without the unheralded work of Underwriters' Laboratories."

This institution occupies a peculiar place. Utterly impersonal, completely non-commercial and as impartial as the weather, it pays no dividends, makes no profits and devotes all its energies to one undeviating purpose—*the ascertainment of fact.* In doing this it has built up an extraordinary plant and has assembled a large force of technical engineers. The nature of its work is summed up in an extract from an official statement, as follows:

> Underwriters' Laboratories, Inc., was established and is maintained by the National Board of Fire Underwriters, for Service—Not Profit.
>
> The object of Underwriters' Laboratories is to bring to the user the best obtainable opinion on the merits of appliances, devices, machines and materials with respect to life, fire and collision hazards, and theft and accident prevention.
>
> The work is undertaken as one means of reducing the enormous and disproportionate loss of life and property by fire and accident.

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A Non-Commercial Institution

It is unusual to find a non-commercial institution operating in a commercial world as the direct off-shoot of a great business interest. Yet the reason is simple enough: the insurance companies require accurate knowledge of all elements of hazard if their underwritings are to be more than mere guesswork and gambling with chance. Such knowledge, therefore, is the foundation for a vast system involving billions of dollars' worth of protection and underlying the entire credit structure of American business. With this incalculable interest at stake, personal opinion and human bias must be eliminated and knowledge must be painstakingly obtained through the highest technical skill and the most complete equipment.

It chances that this is a matter of public as well as of underwriting interest, for the discovery of hazard points the way to its avoidance. Therefore the work of the laboratories is having a profound effect in raising the standards of American industry and in increasing the safety of the general public. The proof of this statement can be given in a single sentence: In 1915, the Underwriters' Laboratories issued to manufacturers some fifty million labels, but in 1921 it issued approximately *five hundred million*, and this huge increase was a natural growth during only six years' time, being made virtually without efforts.

Whether one understand the meaning of this statement or not, one cannot ignore it, for five hundred million is an impressive figure; it represents nearly five labels for each man, woman and child in the United States. What, then, are these labels and why are they in such demand?

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"Peering Through One Peep-Hole After Another" (P. 38)

During all fire tests an engineer carefully notes what is happening to the safe under test.

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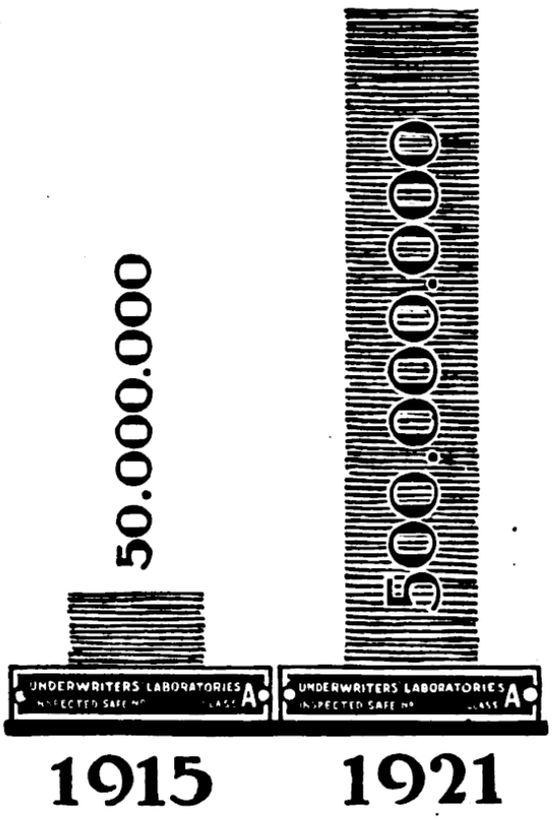

In order to answer these questions, we must first glance at certain conditions of American life.

One of the outstanding features of the present day is our nation's appalling fire loss. Approximately fifteen hundred times every day a fire breaks out of bounds in some locality, and, acting after the manner of fire, it begins to destroy. In other words, more than once each minute, day and night, three hundred and sixty-five days in the year, busy flames start on their natural occupation of turning valuable possessions into valueless smoke and ashes in homes, stores, factories, schools, warehouses, or other buildings. Many of these fires are large and some reach the dimensions of conflagrations; that is, they rage over considerable areas and cause great loss. The total fire loss in 1921 included thousands of human lives and reached nearly $500,000,000 in property value.

It can thus be seen that fire hazard is one of America's largest problems.

Try for a moment to visualize this process of destruction with the roaring flames, falling walls, thundering engines, hurrying firemen; then set over against the confused picture that of a long, quiet building having three stories of reddish-brown brick, and many peaceful-looking

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windows. It is hard to realize that this tranquil structure is America's chief resource in its defense against such a tremendous public menace and that behind these walls, "Science is waging the war of Civilization with Fire."

In order to understand how this can be, one must remember that fire destruction always implies two things, viz: Fire Causes and Burnable Conditions.

Fire Causes and Burnable Conditions

Fire Causes are often unexpected but they are never unnatural; they are the results of natural laws operating in ways that can be studied by Science. Once these laws are determined and their application is understood, it is possible to foresee the fires that will naturally result from certain conditions. Forewarned is forearmed. If people learn how fires are caused they will know how *not* to cause them. This is not as simple as it may appear, for fire may be caused in an astonishing number of ways, but it is one of the great divisions of the subject of Fire Protection. Being so, it engages the constant attention of Underwriters' Laboratories. *At no other point in the world is so much scientific research given to the subject of Fire Causes.*

An even greater amount of study is devoted to Burnable Conditions. Every fire, however caused, is a potential

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conflagration; it will never stop as long as it can find things to burn. What materials will burn? Under what conditions are they most likely to spread a blaze? Why do massive buildings of fire-resistive stone and brick often prove to be fire-traps for their contents, as in the case of the Equitable Building in New York and the Parliament Building at Ottawa? Why do conflagrations race over the roofs of cities, as at Atlanta and elsewhere? What are the various grades and conditions of fire-resistance and how may they be attained at reasonable cost?

Such questions as these—hundreds of them—require answer if progress is to be made toward safety, and again it may be said that *at no other point is such a combination of technical ability and resources brought to bear upon the practical solution of these problems.*

Protection and Extinguishment

Again, there are the subjects of Protection and Extinguishment, both of which assume that fire has broken out of bounds. The first of these is concerned with such matters as safes, shutters, fire-doors and similar devices, while the second deals with extinguishers, sprinklers, hose, hydrants and the many elements of actual fire-fighting.

Merely to name these subjects is to indicate their importance. An apparently trifling difference in material, design or method of use may suddenly prove to be a matter of life and death or at least of large property value. In a fire crisis, there is no time to inquire whether this or that result may be expected. Such things must not be guessed at; they must be proved — positively proved —in advance; which is to say, that they must be given

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"Once More Examined by Trained Eyes" (P. 45)

After fire tests, safes are scrutinized and then torn apart so that the heat effects on the hidden insulation may be studied.

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the terrific tests of severe fire under keen scientific observation *before* human life or property is made dependent on them. *Nowhere else is this testing carried on to a degree that even approaches that of the work at Underwriters' Laboratories.*

One who passed the quiet building at 207 East Ohio Street, Chicago, would receive the surprise of his life if told that at two or three points behind its walls there might then be raging, in effect, conflagrations as severe as those of San Francisco or Baltimore, while trained scientists, with the last word in scientific apparatus, were making close observations that would affect the safety of life and property at a thousand points. Yet this is exactly what occurs in the testing furnaces.

For example, the conflagrations at Baltimore and San Francisco showed that great loss was caused by column failure, particularly in the case of modern sky-scrapers. Steel frameworks that some thought to be fire-proof were found to soften under conflagration heat and to buckle beneath the weight of many stories. Various heat-resistive coverings that had been able to protect the steel columns in moderate fires proved inadequate when subjected to such a terrific trial. In many cases they were

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found to have crumbled, exposing the steel, which thereupon had softened and bent as before. The question of column protection that would really protect in a great fire became one of the big problems of building construction. Accurate knowledge was necessary—knowledge obtained under *conflagration conditions*; in other words, under the combination of intense heat and tremendous pressure that might be met with in an emergency.

The One Place

It was agreed by all hands that the one place where such tests could best be made was Underwriters' Laboratories and they were accordingly jointly conducted at the Laboratories by the Associated Factory Mutual Insurance companies, the National Board of Fire Underwriters and the Bureau of Standards of the Department of Commerce. It took five years to prepare for the test by assembling over a hundred full-size specimens of columns and column coverings, and by constructing a gigantic combination of hydraulic ram and gas furnace capable of exerting a vertical load of over 250 tons to a column while it was exposed to a heat of 2,400 degrees Fahrenheit in eight hours. The research then consumed two years but it furnished exact knowledge for the architects and engineers of the world.

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At various times cities have been swept by great conflagrations that usually have spread from roof to roof by means of flying brands and sparks. This danger has caused many manufacturers to attempt the production of roofing that should be fire-resistive and yet cheap enough to compete with wooden shingles. Underwriters' Laboratories conduct frequent tests of such roofings. It exposes them to radiant heat and to actual flames. In the latter case it is able to duplicate the high wind generally present in conflagrations through the use of a "wind machine" that can furnish a gale of any desired violence. There is no guess-work about any type of roof that has won a Laboratories' rating.

These are but two of the many heat tests which apply to a wide range of materials and products and require specially designed furnaces and the most improved regulating and indicating instruments.

In chapters III, IV and V, the testing of safes will be described more fully, but now it may simply be noted that this hive of scientific activity is pushing its investigations at the same time in many other directions. The mere record of these is almost bewildering; a layman would hardly dream that every-day hazards could involve so many different elements, yet as he goes from department to department, each equipped with the highest type of testing apparatus, and sees scores of thermal, electric, hydraulic, structural, chemical, automotive, aeronautic and other classes of engineering experts, all intent on particular problems, he may begin to realize that certain big and vital things are transpiring beneath this roof.

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"The Temperature-Indicating Instruments" (P. 36)

The engineer at the left controls furnace temperatures by instructions through the speaking-tube.

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Here are a few of these activities:

Testing electric devices, wires, cables, switches, fuses, insulators, cabinets, plugs, cords, etc., of which more than 35,000 different makes and styles have so far been passed upon.

Testing the product of hundreds of manufacturers of fire-doors, shutters, windows, frames, wall-board, roof coverings, partitions and other structural materials.

Ditto with regard to pumps, hydrants, sprinklers, fire hose, valves and all the multiplicity of supplies coming within the range of the hydraulic laboratories.

Making a great variety of chemical tests of materials and products entering into direct use or into the process of manufacturing other products.

Studying the hazards of gases and oils and of devices for controlling or reducing such hazards.

Investigating the efficiency of alarms and signals, both for public and for private use.

Delving into the whole field of casualty reduction and accident prevention, of automobiles and automobile appliances and automobile theft retardants, of burglar protection appliances and systems, of aeronautic safety and of so many other things that a volume would be required for their listing.

In all these directions the work is not academic but intensely practical and so authoritative that it has had a positive effect on every industry. Some industries have been created as a result of it while others have been thoroughly house-cleaned.

The main testing station with its 50,000 square feet of floor space, its 150 officers, engineers, assistants and em-

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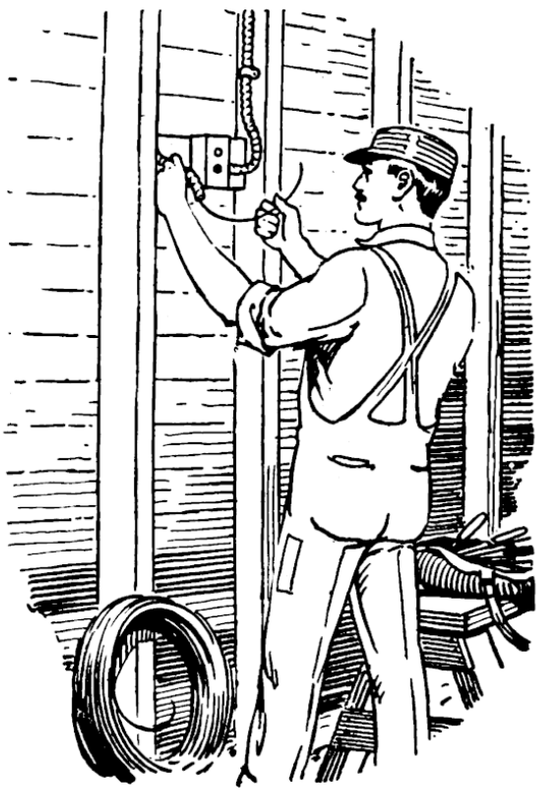
ployes and its notable assemblage of scientific apparatus, is one of the most interesting places imaginable. It well repays a visit, even when such visit involves a trip of hundreds of miles.

However, Underwriters' Laboratories is not physically confined to the buildings on East Ohio Street in Chicago. It has a large laboratory in New York and many smaller testing stations throughout the country. It has branch offices or agencies in every large city in the United States and Canada, and a connection in London, England.

Its activities are not restricted to laboratory research and tests, but permeate the fabric of our daily lives to an unimaginable extent. For example, hardly a foot of electric light wire is used in your home that is not inspected and labeled by Underwriters' Laboratories. The quality of more than fifteen thousand different products made in over five thousand factories is constantly inspected by Underwriters' Laboratories.



As for personnel, in addition to a staff of trained engineers distributed throughout its territory, the Laboratories, through membership in its various Councils, enjoys the collaboration of many important consultants not on the payroll but serving by reason of official positions.

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The total number, and combined influence, of what might be called the "unofficial personnel" of the Laboratories is too considerable to be estimated, because of the great amount of joint research and committee activities involved. Suffice it to mention some important bodies with which there are points of contact:

> The American Society for Testing Materials, the National Fire Protection Association, which is a federation of over a hundred societies and official bureaus, the National Automobile Underwriters' Conference, the National Board of Fire Underwriters, the many underwriting inspection bureaus and their sub-divisions, the Fire Marshals' Association of North America, the National Safety Council, the American Society of Safety Engineers, the American Institute of Architects, the American Concrete Institute, the Chamber of Commerce of the United States, the Society of Automotive Engineers, the National Gas Engine Association, the American Engineering Standards Committee, the U. S. Bureau of Standards, the U. S. Bureau of Mines and many other Federal, State and Municipal governmental bureaus and departments, many commissions appointed by Governors and Mayors, a number of industrial bodies such as the Associated Manufacturers of Electrical Supplies, the Electrical Manufacturers' Council, the National Lumber Manufacturers' Association, the Hollow Tile Association, the National Automatic Sprinkler Association, the Associated Metal Lath Manufacturers, the Fire Extinguisher Exchange, the Rubber Association of America, the Portland Cement Association,—and, of special interest here—the National Association of Steel Furniture Manufacturers.

The Authoritative Label

We have said that this work is having a constant and helpful influence on public welfare. One way in which this has been made manifest is through the label system, to which reference has already been made and of which, as it applies to light weight safes, more details will be given in the following pages. Suffice it to say at this point, that the results of the Laboratories' tests of any given products are certified to the users of these products by means of classi-

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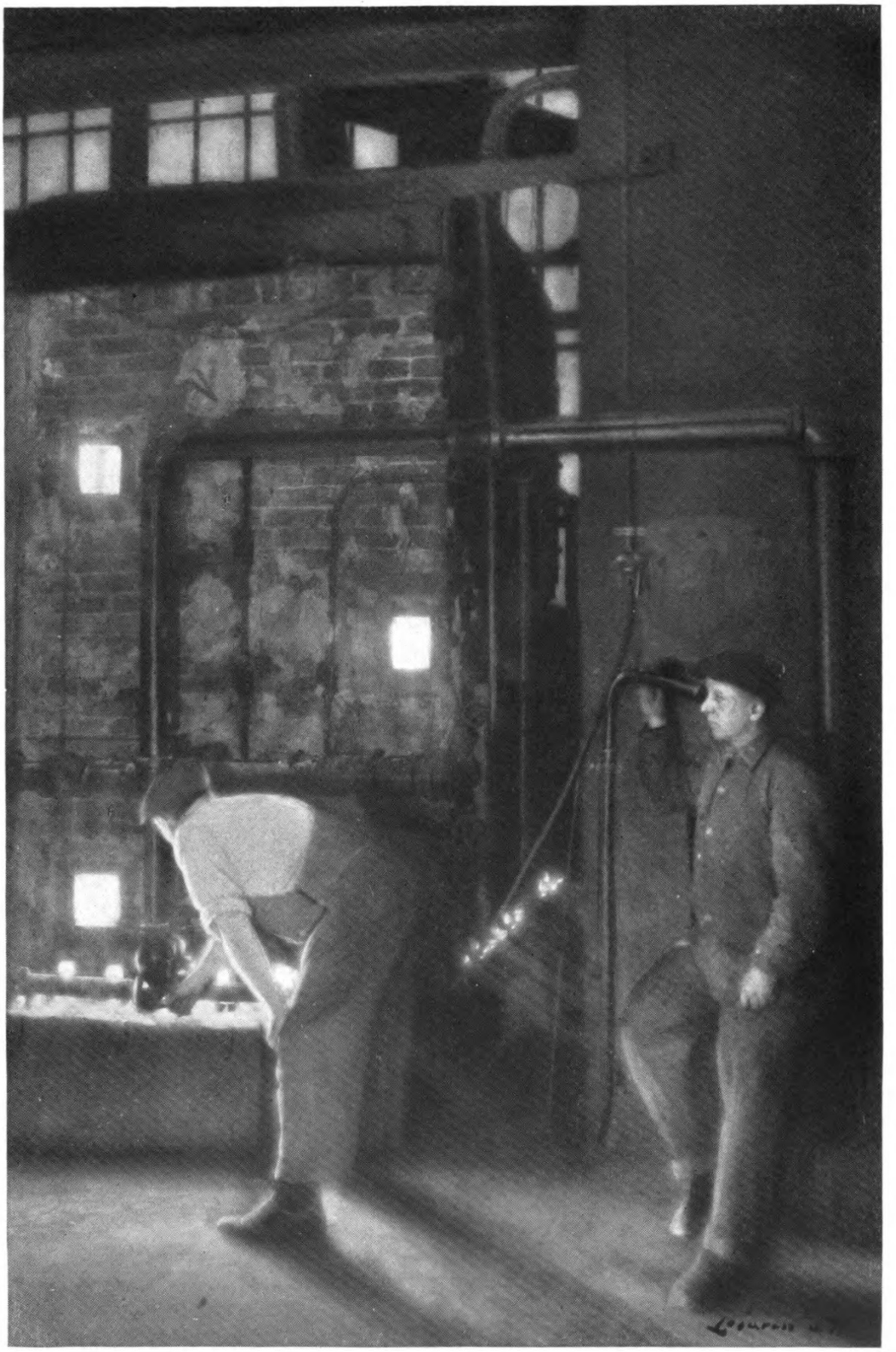

"A Little High in the North!" (P. 38)

During all fire tests, the temperatures surrounding the safe under test are increased according to a definitely prescribed rate.

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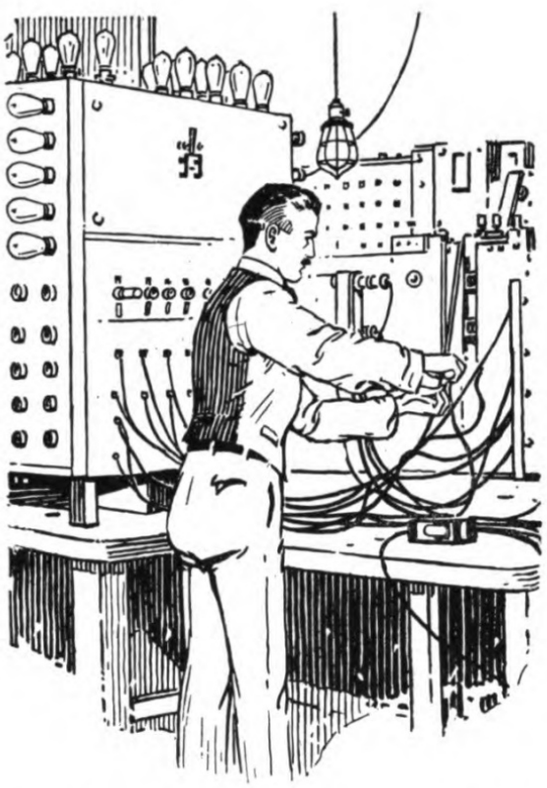

fication labels that have come to be regarded as the last word of authority in many industries. These necessitate the maintenance of a large force of Laboratories' inspectors who supervise goods and processes in the factories themselves in order to make sure that the Laboratories' Standards are constantly maintained. This activity is a tremendous one in itself and requires the services of approximately 250 inspectors operating from over 100 agencies and branches in all parts of this country and Canada.

Thus, an institution that has been too busy to court publicity and therefore is little known to the great mass of the public whose safety it conserves, has grown into its great proportions and its scientific and industrial standing through sheer quality of its work.

All this carefully won standing would disappear if there were the slightest suspicion of unfairness. The Laboratories places its facilities at the service of all manufacturers within its various spheres of operation and *treats them all on an absolutely equal basis.*

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CHAPTER III

Fire and Impact Test

OF the thousands of devices submitted at the Laboratories' main testing station, safes are among the few the testing of which presents really spectacular features. Let us then journey to 207 East Ohio Street, Chicago, and enter Building Number Three when a safe is to be tested. We may find already gathered a representative group of interested spectators, among them a visiting fire chief, municipal and state officials, an engineering college professor with several students, committees from scientific or technical societies, and—trying hard to appear nonchalant—the inventor, the chief engineer or the president of the safe manufacturing company.

There are ten furnaces in the building, which has been constructed specially to accommodate them. The safe test furnace stands next to a large door opening into the yard. It is a huge box of thick masonry with one wall hinged as a door. This is now open—and empty. Where is the safe?

"It will be brought in presently," explains the manufacturer's representative. "When submitting our safes

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to the Laboratories," he continued, "we made certain claims. We said that they can be moved by ordinary labor without fear of damage, and the engineers have been verifying this. They take nothing for granted. They started the test by examining the burlap and excelsior protection and the heavy paper wrapping. They weighed the safe packed for shipment and unpacked. They examined the wheels. They unloaded the safe, rolled it over on concrete, over boards and on skids, moved it with levers, lifted it, using both skilled and unskilled labor and watching everything closely. Well, here she comes now! You can see for yourself that there's not the least damage."

We see, but, of course, we don't know just what to look for. The Laboratories' engineers do know. They closely examine the exterior finish, especially at all joints, for evidences of racking or distortion. They open and close the doors. They make many notes. Finally they give the signal to a crew of workers who lift the safe onto a wheeled platform which is rolled into the furnace and forms its bottom.

"These engineers are from Missouri," comments the manufacturer's representative, admiring their thorough-

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ness, "You should have seen them put our safe through their *operation tests*. They worked the doors and locking mechanism a number of times to determine how easily they could be manipulated. They did this with the safe resting on all four wheels, then with two opposite wheels raised by steel plates. They exerted certain upward and downward pressures on the opened doors to see if there was any bending. In every case they used little dabs of soft putty to note the accuracy of fits at door edges."

Meanwhile the furnace and the safe in it are being prepared for the ordeal. Magazines, index cards, blueprints and loose papers are arranged on the shelves of the safe, many of them in contact with the inner steel walls. A photograph is taken of this arrangement. Several five-foot lengths of half-inch iron pipe are stuck through small holes in the furnace walls, and adjusted so that their ends almost touch the sides, top and bottom of the safe. "These are electric thermocouples, or pyrometers, —I might say *thermometers* to make myself understood by a layman," explains an engineer. "Inside these iron pipes are two wires, joined at the hot tip. Heat generates an electric current which can be measured exactly. Its strength gives us the exact temperature, at any time."

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Another engineer is connecting the wiring and examining it. We follow him into another building, to which the wires lead. Here, away from the heat and roar of the furnace room, are the switchboard and the delicate temperature-indicating instruments. The engineer tests all circuits to see that everything is in order.

The apparatus is very complicated, but one device seems familiar: "What is this funnel for?" we ask.

"Oh, that is a speaking tube to the gas control station beside the furnace."

We return to the furnace, and notice that there are a number of gas burners inside along the bottom of each wall. On the outside are gas and air pipes and a number of main and auxiliary valves by means of which the furnace temperature can be regulated to a nice degree.

Now the safe is closed and another photograph is taken to show its exact appearance before the ordeal. Next the ponderous furnace door—a hinged, steel-framed cement-block wall—is swung to with a jar and is propped shut by means of a strong iron beam. A man with a trowel seals the chinks all around with the special cement. Another worker appears with a kerosene-soaked torch. He lights it.

"Time!" commands the engineer in charge. We all look at our watches.

"Go!" The gas is turned on, the burners are lighted and the heat has begun.

As the heat first begins to be apparent, we notice in all four walls of the furnace small mica peep-holes. Through them may be dimly seen the safe as well as the semi-luminous flames that light it.

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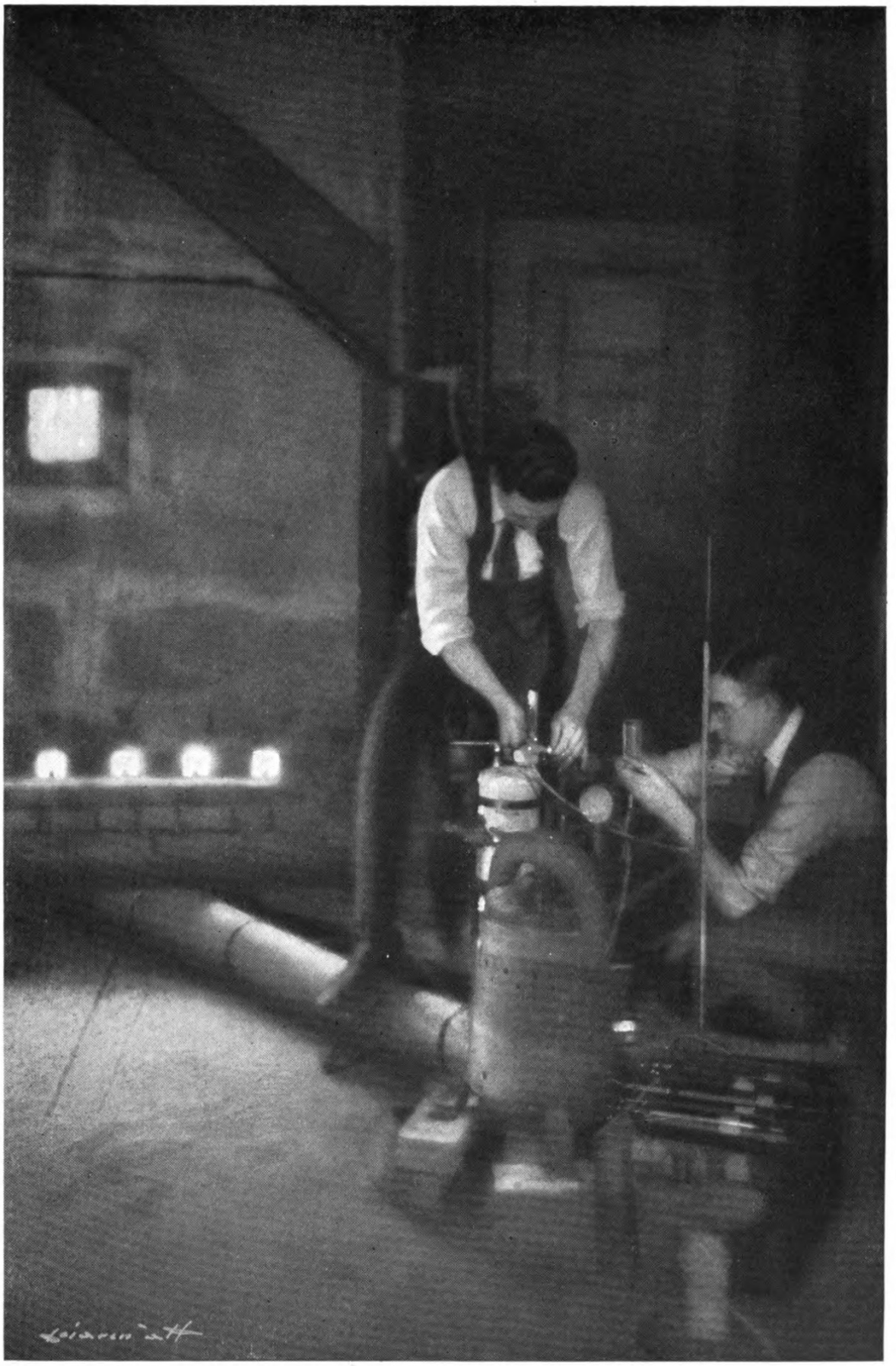

"Taking Samples of the Air from the Interior" (P. 47)

This is done by means of a pipe passing through the bottom of the safe for subsequent chemical determinations of gases formed.

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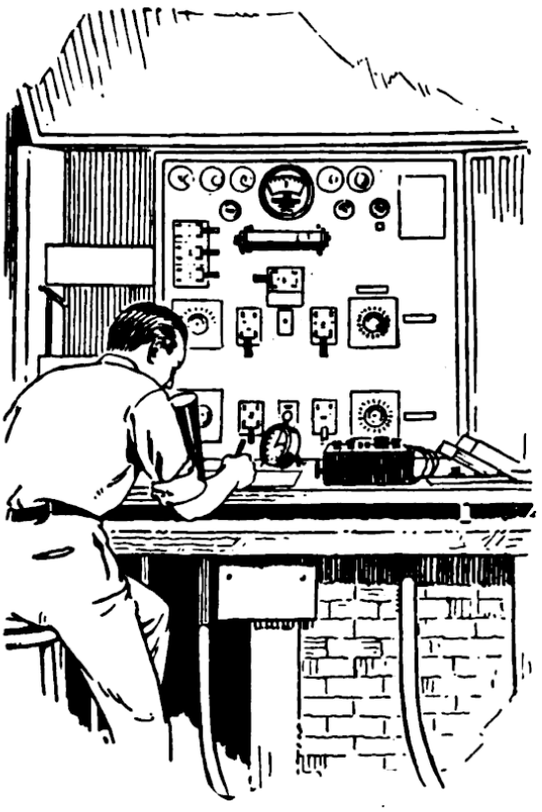

The first effect we note is that the beautiful paint and varnish surface is beginning to blister.

Five minutes have elapsed.

The activities of the assistant engineer now engage our attention. He is jumping from one peep-hole to another, peering keenly through and jotting down on a sort of time-table all that his trained eye sees.

We become conscious that a voice has been raised every few seconds since the beginning of the test, in mysterious phrases such as: "A little high in the North . . . low in the East. . . ."

It is the man at the speaking tube, repeating what is shouted to him by the engineer at the temperature-indicating instruments. With every message the proper valve adjustments are quickly made on the North, South, East or West walls. Evidently, the temperature must rise at a predetermined rate. Without being told, we know that the idea is to subject all safes to the same heat conditions.

Ten minutes have elapsed. The valves have been opened wider all around, and the flames roar in earnest, though greatly muffled by the thick masonry. The test becomes thrilling to the least technically informed spectator.

The division engineer has an eye to everything, like the captain of a ship, and his crew is well-drilled and

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expert. He has hardly spoken a word, nor will it be necessary throughout this test.

Fifteen minutes. Looking through a back peep-hole we observe that the large sheet of steel forming the back of the safe begins to show visible distortion; this, however, is a usual condition.

The Completion of the Heat

Twenty minutes have now elapsed. The assistant engineer calls our attention to a tiny spurt of flame issuing from a joint, and explains that it is a normal phenomenon—in fact, if there were no provision for the escape of gases formed within the insulation, the pressure might do some damage.

Twenty-five minutes. The steel knob of the combination lock glows red. The entire visible surface of the safe begins to redden.

Two workers begin arranging block and tackle and other devices for opening the furnace door and pulling out the bottom truck on which the safe rests. An engineer explains that this would not need to be done in the Endurance Test. It appears that there are various kinds of fire tests. In the Endurance Test he tells us, the safe is submitted to the heat of the furnace for a specified length of time which varies according to

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the class of label being tried for. The temperature *inside* the safe, as indicated by means of electrical thermocouples within it must not reach 300 degrees Fahrenheit—a low temperature for an ordinary kitchen oven, and one which will not damage paper.

"This is the Fire and Impact Test," he continues; "and the heating will last just one hour, at the end of which time the safe will be taken out, pulled into the yard, hoisted thirty feet and dropped. Tomorrow, we will turn it upside down and reheat it for another hour, then leave it to cool slowly in the furnace and, the day after, it will be opened to see if the papers inside are charred. If they are or if various weaknesses develop, the safe does not get our label."

Thirty minutes. Approaching a front peep-hole we see that the joints of the safe begin to close, indicating that the expansion is becoming uniform.

Fifty minutes. The combination knob is white-hot.

Fifty-five minutes. Eight men in overalls stand by at their stations like a trained gun crew—each knowing what he is to do.

Fifty-nine minutes. The engineer at the instruments, cool and calm inside the other building, takes a last read-

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ing of all temperatures, jots them down, and puts his mouth to the speaking-tube: "Ready!" he calls.

"Ready!" is the answer.

Two asbestos-gloved men disconnect the thermo-couples and withdraw them, white-hot, from the furnace wall holes.

"Ten seconds!" shouts the assistant engineer.

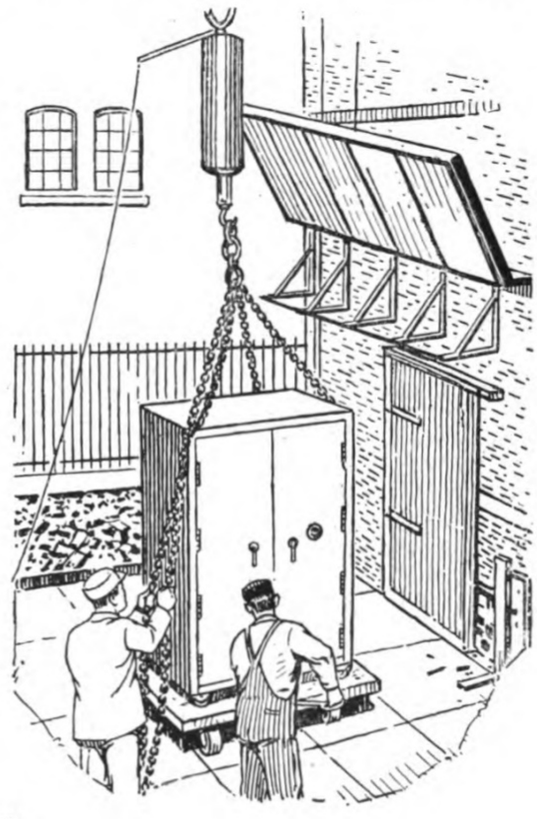
No one moves, because everyone is ready.

"Five."

A man grasps the main gas lever, controlling a quick-shutting gate-valve.

"Go!"

The main valve is shut and the flames go out with a pop. At the same time there is a thud as a man swings a timber ramming loose the furnace door prop, which is immediately caught by another man. The ponderous door opens, causing the spectators to fall back because of the tremendous burst of radiation from within the furnace. The first heat has been completed.



Now the red-hot safe itself advances majestically upon its truck. Four men approach and quickly shackle it with a clever contrivance of chains and bottom bars. This job is done in a twinkling and they then

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jump away to escape the heat. The hoist motor begins to hum and the steel cables above to tighten. The safe rises in the air, with the speed of an elevator. At the same time the derrick boom from which it hangs swings it until it is just above a massive concrete block flush with the flooring of the yard and covered with loose bricks to a depth of about six inches.

From one of the bars supporting the safe dangles a chain exactly thirty feet long, with an iron weight at its other end. The moment it straightens, the trip hook of the chain sling is yanked free, and the safe comes whizzing down from the height of a fourth-floor window.

It crashes loudly upon the pile of bricks. We all come as near as we can.

The safe has not dropped quite squarely, and besides, the bricks are purposely uneven, to represent the chaotic débris into which safes may drop when floors give way in the course of actual fires. At any rate, it seems that almost the entire force of the fall has been absorbed by one corner, which is seriously distorted and shows the white insulating substance through the glowing surface as a wound might show white bone through crimson flesh.

One cannot help feeling a certain degree of pity for the sorely-tried inanimate thing.

But the manufacturer's representative, in his excitement disregarding the fierce heat, approaches within about two feet, examines the wound, and comes away smiling with satisfaction.

What of the inside of the safe? How fared the magazines, blueprints and loose papers? Can it be that they

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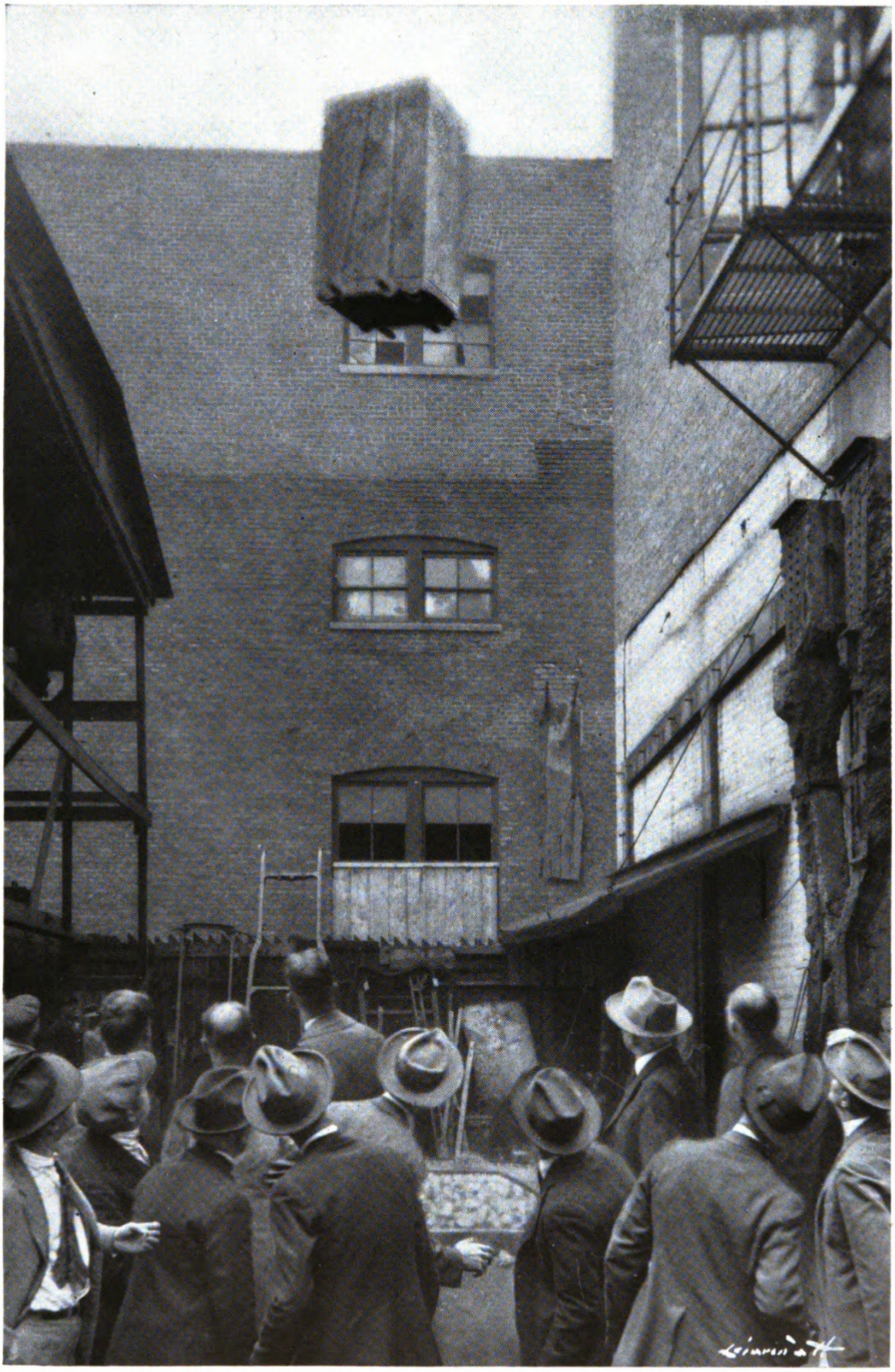

"The Safe Comes Whizzing Down" (P. 42)

Immediately after the safe is taken from the furnace it is hoisted thirty feet then dropped on a pile of bricks.

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are not even scorched?

"Certainly!" chorus all those to whom these tests are mere routine. "One hour is nothing."

Nevertheless we burn with curiosity. But we shall not know for two days.

When the safe has cooled, examinations are made covering its stability and strength. We are told that the engineers look especially for such bulgings or separations as would affect the tightness of closure at the doors or elsewhere. Any bendings, breakage or collapse of parts showing evidences of lack of requisite strength would be counted against the safe. It gives us pleasure to learn that the damage at the corner on which the safe fell is classed as normal. "But wait," we are told. "This test is not over. Come again to-morrow at nine."

The Re-Heat

The next day the safe is placed *upside down* on the furnace truck, reinstalled in the test furnace and again subjected to the inferno for one hour. This is known as the Re-Heat after Impact. The furnace conditions are as in the first heat, and the assistant engineer again peers through one peephole after another watching keenly for any sign of buckling, sagging, warping, separations, collapse, fusion, disintegration and so on. We think of the

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effect of the thirty-foot fall while the safe's outer shell was red-hot. Was the reinforcing frame strong enough? Was it sufficiently protected against softening by the terrific heat? If too weak, or too soft, the three-story drop must have caused cracks in the insulation which would be invisible from the outside, and then good-bye to the delicate papers inside!

We begin to realize the studied severity of Underwriters' Laboratories. It seems hard on inventors and manufacturers. But it is all planned for the protection of the public.

The third day, the furnace is opened, revealing the discolored exterior of the safe, which is now cool enough to handle. It is rolled out, photographed again, and once more examined by trained eyes. All we can observe, beside the injury to the corner on which it fell, is that the once shiny surface is now roughened and distorted. The examination of the outside being over, the doors are forced open.

This is the most exciting moment of all, for we now can see the contents of the safe. They prove to be somewhat disarranged from the dropping and turning over but they have suffered no apparent damage from heat. While a photograph is

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taken, showing the interior of the safe, we venture to express the hope that it has passed.

The engineers do not answer. They seem to have no feelings. They are of course satisfied that the papers are uninjured but nevertheless they go ahead with their work: They make notes of the condition of the paint or enamel on the inside, and investigate also the condition of the internal equipment, the locks, the fastenings between the parts and the condition of every feature. More photographs are taken and then an autopsy is performed: Workmen take the safe apart, dissecting it as a coroner would a corpse, while the engineers carefully note the visible effects of the ordeal and take samples of steel and insulating substance from various places for physical and chemical tests which are as significant, from a scientific standpoint, as the striking evidence of the unscorched papers inside.

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CHAPTER IV

Endurance and Explosion Tests

SPECTACULAR as was the Drop Test, we learn that it is not regarded as the most important; it is still necessary to determine *how long* a safe can protect its contents from damage. This is done by means of the Endurance Test which lasts three-quarters, one, two or four hours. The temperature inside of the safe must not reach 300 degrees.

Those safes which are claimants for Class B labels must resist the intense heat for at least two hours and the Class A labels call for at least four hours' protection. As a matter of fact, these figures are often exceeded.

One of the interesting features of this test is the taking of samples of air from the interior of the safe during its ordeal in order to make chemical analyses and determine whether there is any generation of gases that will be likely to harm contents or cause explosion.

When the time is up and the gas has been turned off, the safe is left to cool slowly *in the furnace* and the engineers continue to make readings of the temperature. "You

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see," explains the manufacturer's representative, "if the safe were in a real fire it might be several days before it could be opened. In the meantime, the heat would exert a cumulative effect on the papers which it is absolutely necessary to guard against. It is said that sometimes in private tests the doors are opened as soon as the burners are turned off so that the heat is lowered at once. Such a 'test' is absurd from the standpoint of anyone who wishes to get at the real facts of protection. You wouldn't find Underwriters' Laboratories standing for anything in the nature of a 'packed test.' "

We remain a while beside the instruments, and observe that the interior temperature of the safe continues to rise slightly for some time before gradually beginning to cool, although this is not always the case. The engineer remains to watch the "cooling curve" of the endurance test, to observe that the heat units absorbed by the insulation during the fire test period are not dissipated into the safe interior at a rate that will cause the temperature to rise above the critical point.

A Fast and Furious Fire

"Come along and see an explosion test." This is the strange invitation of an engineer. We eagerly follow him to his car, for the test is to be conducted in an open field.

Arriving there we see a safe raised knee-high on four brick piers, and enclosed in an open-front wooden shanty. We observe an instrument in the upper portion and are told that it is a recording thermometer.

A camera is set up facing the opened safe. As we arrive, a photograph is taken, and the doors are closed.

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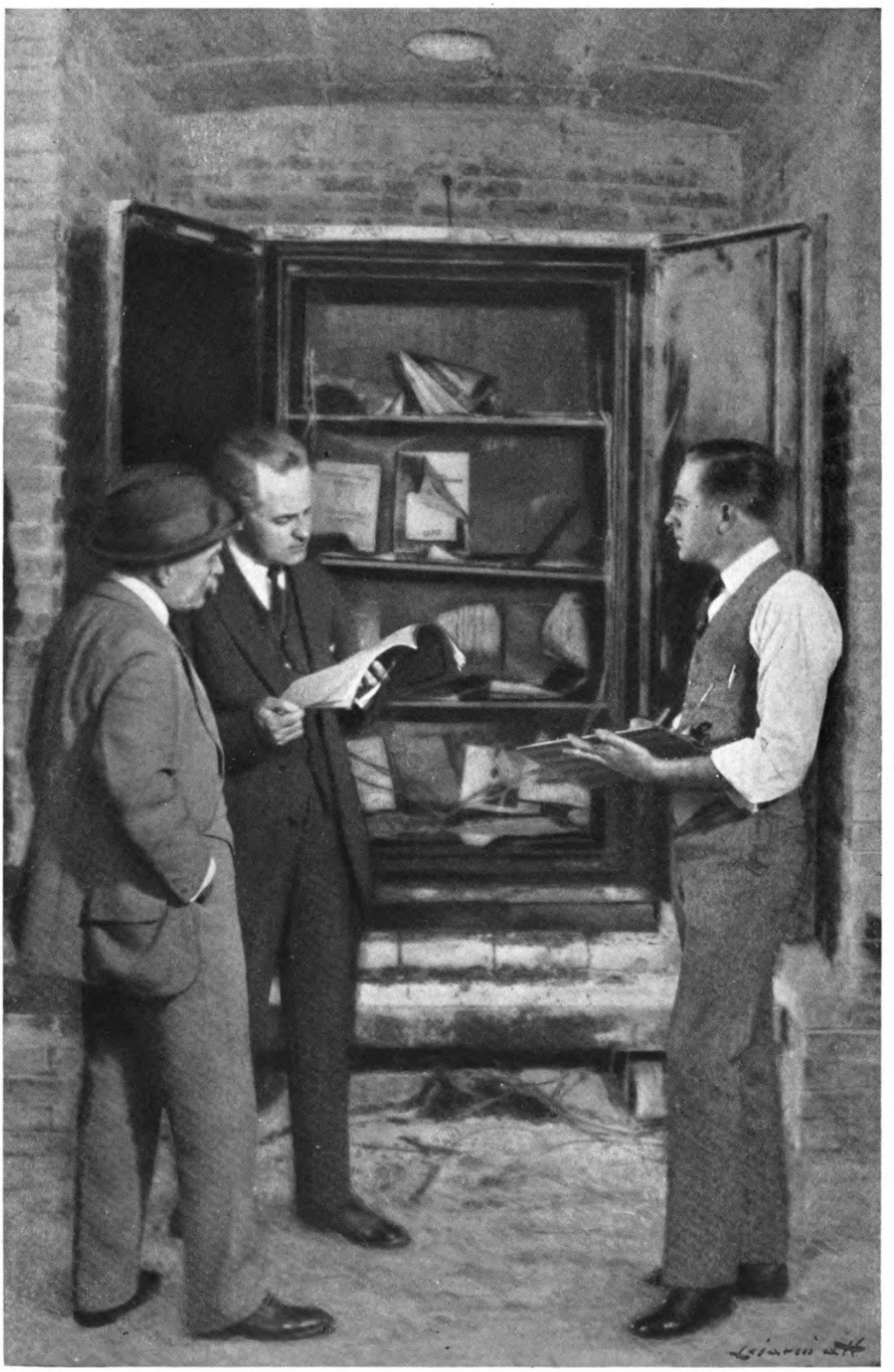

"To See How Long a Safe Can Protect Its Contents" (P. 47)

Examining papers, blueprints and magazines after an endurance test. Note thermocouple wires near bottom of safe.

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Two men now pack kindling wood, shavings and other highly combustible materials under and all around the safe. An eight-foot square wooden section is nailed across the front, so that the safe is completely enclosed. More sticks and boards are packed into the big box by men on ladders, until it will hold no more.

Lastly a man pours the contents of a number of cans over the whole. We recognize the odor.

"Thirty gallons of kerosene," we are told, "and five thousand pounds of wood and excelsior."

It will be *some* bonfire, we think.

Suffice it to state that the fire is both faster and hotter than even the inferno of the furnace. The fuel has not been thrown haphazard but is so arranged that the air envelope enclosing the safe reaches extreme temperatures almost instantly. Will this swift exposure cause explosive gases to form in the safe? That is the question.

At the end of thirty or forty minutes the "hut" and fuel are practically consumed.

The safe is red hot, but apparently nothing has happened to it. We assume it to have stood the test.

But the inquisitive engineers are not so easily satisfied. The next day, when the safe has cooled, they make a thorough survey and discover that certain distortions have taken place here and there. They measure their extent with utmost care, using steel squares, straight edges and rules. *A tearing of metal or opening of door joints would technically constitute an explosion.* With some difficulty the combination lock is worked. The doors are thrown open, revealing an apparently unchanged interior.

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CHAPTER V

The "Why" of the Tests and the "Curve"

LATER we discuss with several of the Laboratories' engineers the bearings of the tests we have witnessed.

Their language is technical and is used with the careful exactness of scientific men, but in a simplified form the discussion runs somewhat as follows:

"Are the tests we have seen the usual ones for lightweight safes?"

"They are standard tests for all safes, of whatever weight. That is to say they are conducted under controlled unvarying conditions."

"Are these your maximum tests for safes?"

"The endurance test you witnessed was not. It was merely the test for its class. The Class 'A' label calls for double the time of exposure and a greater maximum heat, according to the National Standard Temperature Control Curve. However, the tests you saw exceed the exposure offered by most fires."

"You spoke of the impartiality of all your tests. Do test *specifications* as well as their actual conduct have any

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bearing on the question of fairness as between different makes? For example, politicians in advertising bids for city supplies sometimes draw the specifications in such a way as to favor particular goods. Is anything resembling this possible in planning tests of safes?"

"Undoubtedly. If a competent engineer were given a moderately good safe, and time and money enough, he probably would be able to devise a test specification which would appear reasonable and which that particular safe could pass better than any other. The results of such tests would therefore be misleading."

"Are your specifications for tests of safes a matter of record?"

"Yes. They form Section Two of our Standard for the industry."

"Your Standard for the industry—is this an actual document?"

"It is."

"Has it been published and generally accepted?"

"It has been almost universally accepted, and for the very good reason that it was not drawn up entirely in the seclusion of our offices, but was painstakingly developed in the course of four or five years. In its completed form it was referred to our Fire Council for formal acceptance before we regarded it as Standard."

"Your Standard for the industry, then, is a document in which specifications are officially laid down, so as to eliminate rule of thumb methods and arbitrary decisions?"

"Yes; but it does not stop at test specifications; it covers everything from the preliminary arrangements

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"Enclosed in an Open-Front Wooden Shanty" (P. 48)

Packing five thousand pounds of fuel around a safe so as to produce an exceedingly quick and hot fire in an attempt to explode the safe.

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with the manufacturer through the various features of our investigation."

"Would it be proper to compare this Standard to the rules of the Lawn Tennis Association; and to compare a test to a match in which the umpires and linesmen have a great responsibility but nevertheless work under official rules?"

"That's it exactly. We engineers are the umpires and linesmen. We have been instrumental in drawing up the Standard but now that it is published we cannot change it arbitrarily."

"But are you not the final authority on this set of rules?"

"By no means. We have placed ourselves under the Fire Council."

"And what is the Fire Council?"

"It is a body of twenty-eight technical men including officials of the Bureau of Mines, the Bureau of Standards, various bodies represented in the National Fire Protection Association and in national insurance conferences, and others. No person financially interested in the outcome of tests may be a member. Almost every day they render decisions by mail-vote on reports, conclusions and recommendations which we prepare here, and to which we append drawings and photographs as needed."

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"Did they pass on your Standard for safes before it was issued?"

"Of course. Moreover, they review our individual reports on safes."

"Do you mean to say that every time a safe passes your test, you send a report on it to the Fire Council?"

"Yes, and it is always a full report, including perhaps fifteen or twenty photographs. It ends up in a recommendation for classification of the device submitted as 'A,' 'B,' 'C' or 'Insulated Cabinet.' A typical report to Council begins with an introduction discussing the requisite qualities of the class to which the device is claimed to belong, and then describes the device in detail as to its use, descriptions of its parts, and its installation. Then comes a set of drawings, followed by the claims made by the manufacturer as to such things as fire resistance, structural strength, convenience, protection against burglary, durability and portability. We then give an outline of the scope and plan of our investigation and the means used by us in obtaining information. The next section of the report, which is the lengthy one, contains a record of the examinations and tests, each subject divided into Description, Methods and

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Results. After this then come the illustrations—photographs and charts. This, in turn, is followed by a statement of the service record of the device and by a statement regarding the history, financial standing and other facts about the manufacturing company. Our Conclusions are next given, first in detail and then summarized. Last of all comes our Recommendation. There may also be appendices."

"All this is sent to every member of the Fire Council?"

"Yes; and *our Label Service Department does not issue labels until the votes of the members of the Council have been received, counted and found to be favorable.*"

We recall a reference to "Investigation of Materials."

"This begins long before the manufacturer submits samples for the fire tests you have witnessed. Shortly after the receipt of drawings, descriptions and claims, the factories where the safes and insulating materials are manufactured are visited by engineers from this office and from the nearest branch office. All materials are studied, but since the insulating materials are of great importance with regard to durability, they require much more consideration.

"The Durability requirements are plainly set forth in black and white in the Standard. This was submitted to every manufacturer of safes and insulated cabinets whose address could be obtained. After waiting ten months without a single objection of any consequence being received, it was put into effect. Under Durability, the Standard does not fail to require proper design, construction and protection to withstand 'without material

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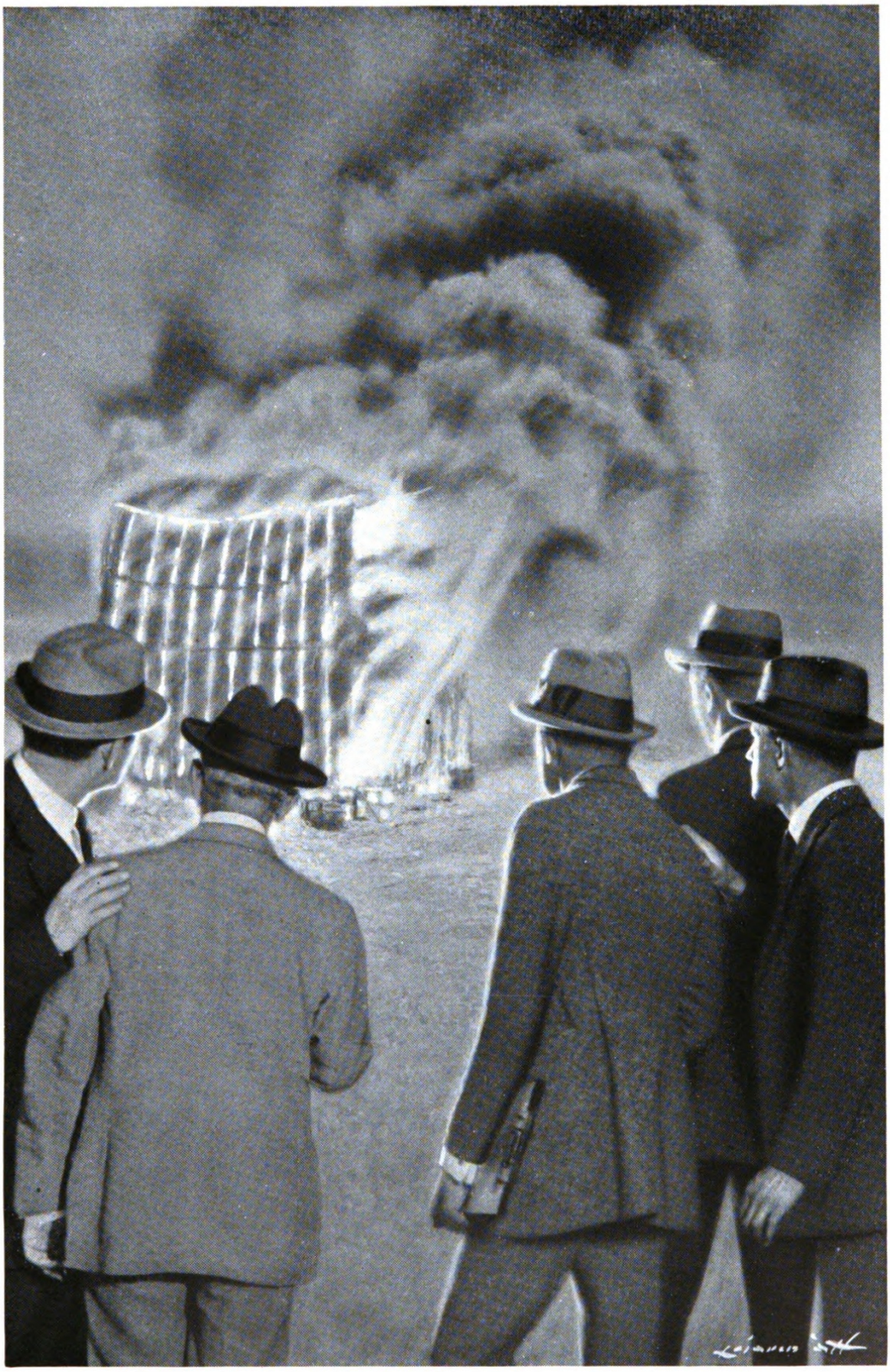

"Some Bonfire, We Think" (P. 50)

Showing the furious fire of kerosene-soaked kindling-wood in the Laboratories' standard "test hut" during the course of an Explosion Test.

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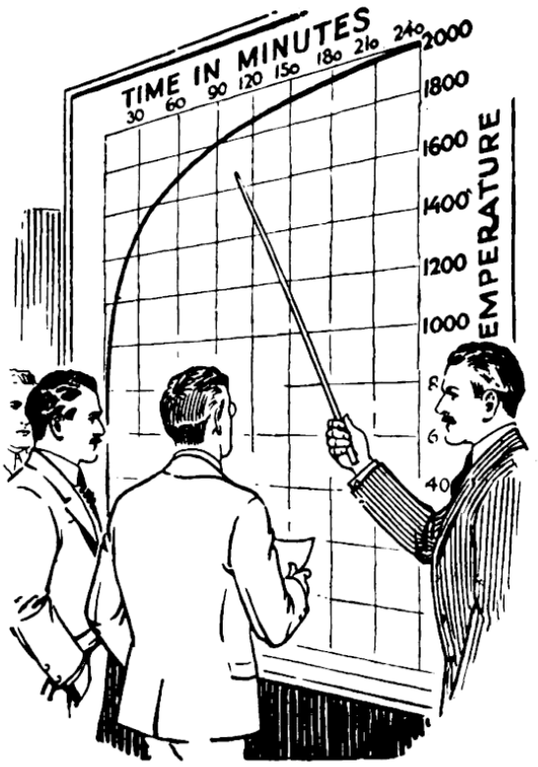
deterioration for indefinitely long periods the inside and outside corrosive influences.' Our requirements for the prevention of corrosion and rust of the metal parts of safes are very strict. But our investigations of materials do not stop with that phase. We consider many others, among them the interesting one relating to the generation of explosive gases and vapors under exposure to heat."

"Do safes ever explode?"

"Most certainly. Go to the actuarial records of the fire insurance companies. You will find instances of safes violently torn apart by the force of internal explosion. Doors have been thrown a considerable distance."

"It is evident that the heat exposure on the bottom of the safe in the furnace was less than on the other five sides; is this deliberate?"

"It is a natural development growing out of experience. As a matter of fact, we believe that the high temperature on five sides subject the safe to worse conditions than it would ordinarily have to meet in the field. The average safe is placed with its back to the wall and therefore one of the broadest sides is not subjected to excessive heat. Very often it is placed in a corner where the back and one side both receive pro-



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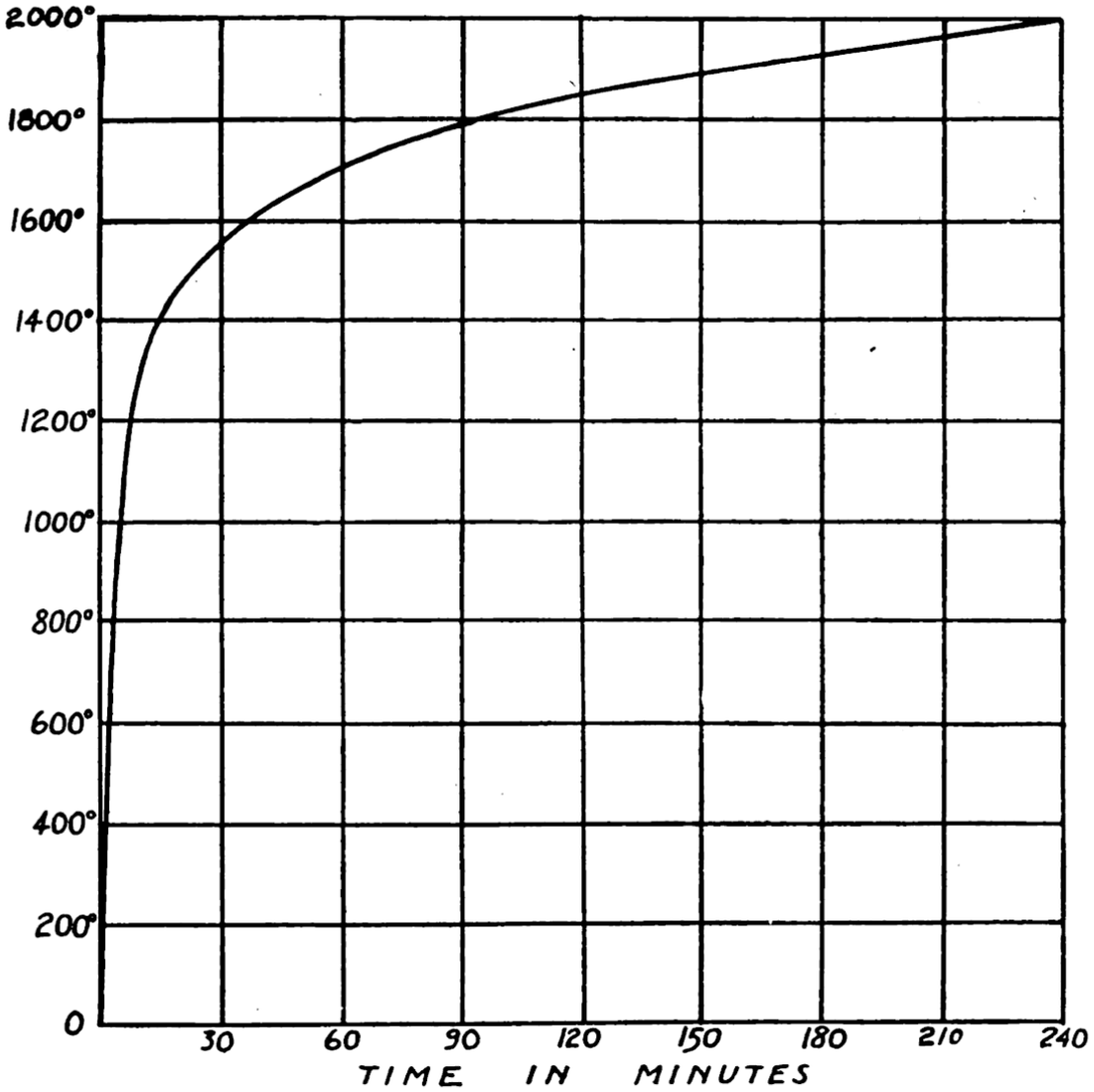

The National Standard Time-Temperature Control Curve

tection and frequently, its top is covered by slow-burning materials, such as books and filing cases. As to the bottom—that comes close to the floor which is generally much cooler than other parts of the room because heat rises. If we were to give the bottom the same exposure as is given to the other sides we would be departing from the conditions to be expected in real fires."

The Meaning of the "Curve"

We recall the voice of the man at the speaking tube, repeating the words of the engineer at the temperature-indicating instruments:

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"A little high in the North—low in the East—" and remember the swift regulation of burner valves following each such message. We realized at the time that the temperature was under careful control and was being made to rise at a predetermined rate. However, the basis of this rate of increase was not equally apparent and we now inquire.

"Yes," says the engineer of whom we ask the question, "the exact heat for every stage of the test has been worked out and charted. It follows the Standard Time-Temperature Control Curve as shown on this chart."

"How was the curve arrived at?"

"It is the result of the observations of the effects of thousands of fires by hundreds of authorities. It is possible through examining the ruins of fires to form a fairly close idea of the temperatures developed by means of the evidence of heat effect on various materials.

"We established and published this curve some years ago. As you can see, the temperature mounts quickly during the first fifteen minutes, because this is the usual condition with actual fires; after this, as with most fires, the increase is more gradual.

"It is arbitrary, of course, as any curve must be, but it is not accidental. Nothing would have been easier, for example, than to draw the curve upward to a heat of 1,500 degrees in fifteen minutes and 1,800 degrees in an hour, instead of our 1,400 and 1,700 degrees. We should have done so, had our experience and observation shown the necessity for it. To do it without such warrant would have been contrary to our whole method of procedure."

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"Chemical Tests Which Are Significant" (P. 46)

Studies by the Laboratories' Chemical Department form an important part of the investigation of every safe submitted for classification label.

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"Has this curve been approved by other organizations?"

"Indeed it has. It has been formally recognized by the American Engineering Standards Committee and is today one of the recognized standards of the engineering profession. Since we published it, it has been regularly employed by the United States Bureau of Standards, the National Fire Protection Association, the National Board of Fire Underwriters, the Building Code Committee of the Department of Commerce, the American Society for Testing Materials, and other bodies. It is the American standard furnace control practice for fire tests and the great majority of manufacturers of fire doors and windows, partitions, safes, elevator shaft doors, etc., recognize it and use it in developing their products before submitting them to us."

"It avoids confusion," adds the manufacturer's representative, "because if everyone who makes safes were to have his own system, the public would be bewildered. An unprincipled salesman could show all kinds of charts and figures to his prospect, and could fill his ears with arguments that only a specially trained engineer could pick to pieces."

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CHAPTER VI

The Purchaser's Problem Solved

LET us pause at this point for a brief retrospect of the steps already taken in determining the fitness of the safe under question to receive the classification label of Underwriters' Laboratories.

1. The manufacturer has made formal application, paid his fee, and submitted drawings, specifications and a list of sizes and weights.

2. He has supplied copies of instructions for packing, shipping, handling, installation and operation.

3. He has had conferences regarding changes in design or construction.

4. He has furnished information regarding his firm's history and standing and regarding the service record of his safes.

5. He has presented the claims he makes for his safe, including the situations for which he advocates it as capable of safeguarding against fire and impact hazards.

6. He has submitted at least two safes, and samples of insulation, steel plates, etc.

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7. The many tests have been made according to specifications.

8. A detailed report, with favorable conclusions and recommendations, has been made to the Fire Council.

9. Every member of the Fire Council has reviewed the report and has voted.

10. At last the safe has been found to comply with the requirements of the Standard (noun) and it is officially declared to be Standard (adjective). It is awarded the label for its class.

11. It is listed, and the name of the manufacturer is included, in that Who's Who of standard American and Canadian products—the Laboratories' List of Inspected Mechanical Appliances, which is promulgated semi-annually. There, both the safe and the manufacturer find themselves in distinguished company.

Is the manufacturer now entitled to draw a long breath of relief? Are his troubles over?

By no means, for now begins the Laboratories' exacting inspection of the actual production of safes at the factory itself in order to determine that every safe sold under labels of the Underwriters' Laboratories conforms, inside and out, in every detail, with the stand-

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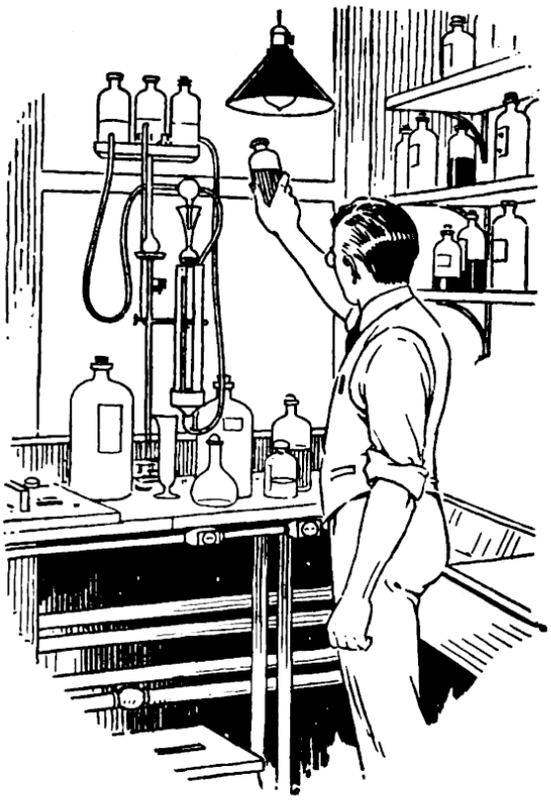
ard specifications. In other words, it is not enough that the label, that badge of merit, be won in the first place—it must also be maintained with scrupulous care.



The Laboratories' follow-up work is so thorough, so detailed, so painstaking, so comprehensive and so severe that comparison with war inspections would be minimizing.

This field work involves the services of more than 200 trained factory inspectors who go minutely into questions of materials and workmanship and thus satisfy themselves that the required standards are fully lived up to: In many lines they take frequent stock samples to send to the Laboratories for follow-up tests and, in addition to this, other samples are purchased secretly in the open market for purposes of checking up the inspector. Thus by every possible means Underwriters' Laboratories guards the integrity of its labels; these are immediately withdrawn in any case where the product is found to be substandard.

The many interesting provisions of the inspection rules will be found in the appendix (pages 69 to 88) where they will well repay reading.

In the case of safes, once a year—sometimes much more frequently, depending on the factory output as evidenced

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from the number of labels—a sample of each of the makes and types is bought in the open market in Maine or California or anywhere else, and shipped to Chicago.

The approximate date of manufacture as shown by the serial number on the label, and other items of information, are noted. The safe is put through the installation tests, the operation tests, and is carefully examined as to workmanship and finish. Then, depending upon its class, type, size, or other factors, it undergoes one of the fire tests—generally the endurance test for its class. Observations and examinations are made as usual. When it has cooled, it is taken apart and examined in detail. Chemical and physical tests are made of samples of the materials taken from various places, outside and within. A detailed report is sent to the manufacturer for his information. This has resulted in a small but constant betterment of labeled safes as sold to the public.

Manufacturers of labeled safes do something like this by themselves. But nevertheless they have expressed their opinion of these Laboratories' tests of marketed safes as a good influence upon the industry—as one of the causes of the good reputation which they enjoy. To which it may be added that manufacturers of unlabeled safes have naturally striven to keep up with their competitors, to the immense advantage of the public.

▫ ▫

This, then, is the story of the arduous processes lying behind a tiny brass badge of honor proudly worn by many thousands of light-weight safes. It must not be assumed that safes of this type are not also burglar-resistant to a

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greater or less degree—as a matter of fact, they are frequently called upon to protect their contents from human depredations—but merely that fire-resistance is the subject of the investigation here recounted. Fire-resistance, therefore, is indicated in the rating as shown by the label. It has been through no accident that this flake of metal has obtained its wide recognition as the *one certificate of quality* in the products which bear it; it has been due to exactly this combination of rigid standards, complete equipment, technical skill, persistent inspections and, above all, to an *impartiality* that is free from every business or personal consideration. Therefore it has come about that the well-informed purchaser of safes, mindful of the importance to his business of making certain of the *fire-safe* qualities of the custodian of his accounts and records, looks first to see whether there is attached to its front the final word of authority—*the classification label of Underwriters' Laboratories.*

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DANA PIERCE } VICE PRESIDENTS
A. R. SMALL }
D. B. ANDERSON, SECRETARY
L. D. HEADEN, TREASURER

AGENCIES IN ALL PRINCIPAL CITIES OF THE UNITED STATES AND CANADA.

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NEW YORK, 25 CITY HALL PLACE
BOSTON, 87 MILK ST.
PITTSBURGH, 324 FOURTH AVE.
SAN FRANCISCO, 205 MERCHANTS EXCHANGE BLDG.

Underwriters' Laboratories

INCORPORATED 1901
ESTABLISHED AND MAINTAINED BY THE
National Board of Fire Underwriters.
FOR SERVICE - NOT PROFIT

STANDARD

for

SAFES

and

INSULATED CABINETS

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Appendix

SECTION I

UNDERWRITERS' LABORATORIES STANDARD TEST APPARATUS FOR SAFES AND INSULATED CABINETS

This section of the Standard includes a general description of the equipment and apparatus regularly employed by Underwriters' Laboratories in the tests and investigations of Safes and Insulated Cabinets.

Introductory

General: Underwriters' Laboratories, a corporation chartered November 1901, by the State of Illinois, is authorized to establish and maintain laboratories for the examination and testing of appliances and devices.

Underwriters' Laboratories was established by, and is maintained by the National Board of Fire Underwriters, For Service—Not Profit.

The object of Underwriters' Laboratories is to bring to the user the best obtainable opinion on the merits of appliances, devices, machines and materials in respect to life and fire hazards and accident prevention.

The work is undertaken as one means of reducing the enormous and disproportionate loss of life and property by fire and the number of accidents in America.

A complete description of the organization, purpose and methods of Underwriters' Laboratories is printed in a separate pamphlet, copies of which may be obtained upon request.

This Standard. This Standard comprises the programs employed by Underwriters' Laboratories in the examination, test and classification of safes and insulated cabinets and the methods of follow-up and labeling. The various sections of the standard are as follows:

Section I —General Description of Equipment and Apparatus employed in the tests and investigation of Safes and Insulated Cabinets.

Section II —Description of prescribed and standard examination and test procedures to ascertain compliance with standards of construction and performance under tests for the various classes of Safes and for Insulated Cabinets.

Section III—The classification of Safes and Insulated Cabinets and standard specifications for construction and performance under tests for the various classes.

Section IV—General description of Label Service Procedure.

Section V —Description of Standard Label Service Procedure for Safes and Insulated Cabinets.

Investigation of Safes and Insulated Cabinets

Preliminary Arrangements. A manufacturer desirous of securing an investigation of his Safes or Insulated Cabinets may do so by first depositing a preliminary fee as evidence of good faith and on completion of the work paying the balance of its cost as shown by accurate records thereof, which are kept in detail. As a warrant that an applicant will not incur costs beyond his expectations, a limit of expense is fixed in each case beyond which charges are not made. By this means an opportunity is afforded anyone at comparatively low cost to secure the opinion of the recognized authorities covering his product in its relation to the fire hazard.

The preliminary fee for the tests, investigations and report on Safes and Insulated Cabinets is one hundred dollars ($100.00), such devices being in group F of the Laboratories schedule of fees listed on the enclosed application blank.

The costs are in proportion to the work required for the investigation and report whether the safes or cabinets show superior or inferior qualities. The applicant's obligation to pay the charges is not, therefore, contingent on the nature of the opinion rendered whether favorable or otherwise. If for any reason the costs do not aggregate the amount of the preliminary fee, the balance will be returned to the applicant.

Blank forms for use in making applications for investigations of Safes and Insulated Cabinets are furnished on request.

Required for the Investigation. The following information and test samples are necessary for the tests, investigations and report on Safes and Insulated Cabinets:

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(*a*) *Drawings and Specifications*—Detailed drawings and specifications of a medium size safe of each class submitted.

(*b*) *Sizes and Weights*—A list giving the exterior and interior dimensions and the weights of each size of the classes of safes or insulated cabinet submitted.

(*c*) *Instructions*—Instructions for packing, shipping, handling, installation, operation and maintenance of the safes or cabinets submitted.

(*d*) *Test Samples*—At least two safes of each class submitted, or at least one insulated cabinet are required for the examinations and tests. One of the safes of each class to be of medium size and one to be of the largest size provided this does not exceed 7 feet high, 5 feet wide and 3 feet deep. Insulated cabinets to be of medium size.

An additional safe or cabinet of medium size may be necessary if the tests and investigation indicate that a fire stream test is advisable.

Heat insulating materials and other special materials are required in sufficient quantities for any separate tests necessary for the report.

Test samples should not be made or shipped until the Laboratories have had opportunity to study the drawings and specifications, inspect the application of the insulation, pass on the special connections for the introduction of the apparatus for the measurement of the internal temperatures, and on the suitability of the condition of the samples for test.

Safes or cabinets submitted for test must accurately represent the commercial product and should be shipped to the Laboratories in the same manner that such product is ordinarily shipped.

(*e*) *Claims*—A list of the claims made for the safes or cabinets, including statements covering the situations for which they are advocated and considered capable of safeguarding against the fire and impact hazards.

(*f*) *Service Record*—If the safes or cabinets have been on the market, a list of users should be furnished, and also any reports covering their performance in actual fires.

Report on Investigation. If the results of the investigation of any single sample or set of samples are favorable, a report is prepared in which definite recommendations for action are made to the Fire Council of the Laboratories by whom the report is reviewed and by whom action on the recommendation is taken. If at any time the results of the investigation show that improvements are necessary, a report is sent to the Submittor setting forth the particulars in which the device does not comply with the Standard.

The report includes a general description of the safes or cabinets submitted, a list of the claims made for the product, the results of the tests and investigations made, a brief statement relative to the Manufacturer, a comprehensive conclusion covering each phase of the investigation, and the recommendations made.

Listing of Safes and Insulated Cabinets. When as the result of investigation, the product of the manufacturer has been judged to comply with the requirements of Standard of the Laboratories for the product, and the Fire Council has concurred in the recommendations in the report, a card is promulgated to subscribers announcing the listing of the product as standard under the proper classifications.

The name of the manufacturer is also included in the List of Inspected Mechanical Appliances which is promulgated semi-annually.

At the request of the manufacturer and at the cost of printing, the Underwriters' Laboratories will furnish printed copies of the official report in the numbers desired.

Supervision of Listed Safes or Insulated Cabinets. The Label Service is employed in the supervision of Listed Safes and Insulated Cabinets. This Service is described in later sections of this Standard.

Underwriters' Laboratories' Standard Test Apparatus for Safes and Insulated Cabinets

The equipment employed in the tests of devices and materials that may be exposed to fire is located in several of the Laboratories' buildings, but the greater portion is in a building specially designed for work of this character known as Building No. 3.

Building No. Three. This building is of fireproof construction having a steel frame protected by concrete and enclosed by brick and reinforced concrete walls. The ground floor is of concrete and the upper floor and roof of reinforced concrete. Sliding skylights that can be opened for ventilation are located over the central and southern portions of the building. The windows are metal, glazed with wired glass.

The building has a ground area of 69 by 70 feet and is one and two stories high, the maximum height being equivalent to three stories. The central portion is one high story, furnishing head room of approximately 37 feet. At three sides of this portion the building is two stories with head room of approximately 17½ feet under the second floor. A brick tower 53½ feet high which can be partly opened to the air at the top is located in the southeast corner of the building, and three brick stacks 58 feet high are built in the brick wall adjoining the tower. A trench for pipes and conduits extends around the four sides of the building. Removable reinforced concrete covers are provided to permit access to the trench.

The first story is undivided, except in the south-eastern portion in front of the tower which is separated from the main room by partitions and a large rolling steel door. The second story is open to the high central portion except a room on the south side which is enclosed by metal lath and cement plaster partitions.

The first story of the building is devoted to the tests of devices and materials requiring the use of furnaces, and to the preparation of test samples for these furnaces. Ten furnaces of different sizes specially designed for test units ranging from full size building columns to 10 feet by 12 feet panels and to the smaller devices and building material units, are located in various parts of the building.

The second story is used for the preparation of test samples and the location of the fans, pumps and tanks supplying air to the test furnaces and pressure to the apparatus by means of which some of the test samples are subjected to loads.

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Apparatus

The apparatus used in the tests of safes and insulated cabinets consists of a furnace in which the test samples are subjected to the Fire Test and in which they are heated before and after the Impact Test; apparatus for measuring the temperatures in the furnace and on the interior of the safes or cabinets; an electric hoist, derrick, slings and tripping device for use in the Impact Tests; a hydrant and flexible nozzle for use when Fire Stream Tests are made, and the apparatus for testing the materials employed in the safes or cabinets submitted.

Furnace No. 3. The furnace employed in the tests of safes and cabinets is known as Furnace No. 3. The furnace proper consists of a combustion chamber approximately 6 feet wide, 4 feet deep and 8 feet high inclosed at the back and sides by solid brick walls and in front by a swinging door consisting of a steel frame filled with brick. The top of the furnace consists of a brick arch provided with a vent leading to a 58-foot chimney stack. The bottom of the chamber consists of a fire brick floor laid on the top of a strong truck, the wheels of which roll in channels in the floor of the building. Mica glazed observation holes are provided in the walls so that all parts of the combustion chamber may be observed.

The furnace is heated by blast burners which discharge into the chamber on all sides through holes in the walls near the bottom, the flames being directed upward by baffle bricks. The burners are connected to the city gas mains and to the Laboratories' furnace blower system, suitable valves being provided for regulating the intensity and distribution of the fire.

Temperature Measurements. The temperatures in the furnace are measured with at least six thermo-couples so arranged as to indicate the temperature of the furnace gases at points about 2 inches from the center of each of the sides of the safe or cabinet under test. The temperature of the interior of the test sample is measured at a point in an upper front corner, in a diagonally opposite upper rear corner with thermo-couples, and in the upper central part with a recording thermometer. The thermo-couple wires and the connecting tube of the recording thermometer are conducted out of the test sample through a specially protected hole at the center of the bottom. The cold junctions of all of the thermo-couples are located in a common ice bath near the furnace and a cable leads from them to a switchboard and temperature measuring station about 30 feet distant. The indications of the thermo-couples are read with a portable potentiometer and those of the thermometer are recorded continuously on a round chart sheet.

Impact Test Apparatus. The apparatus used for Impact Tests consists of a stiff leg 4-ton derrick with 16-foot mast and 24-foot boom mounted on top of a 53-foot tower; of chain slings and a trip hook. The motive power for the derrick is a 4-ton double drum electric hoist.

The yard near the base of the tower is paved with smooth, continuous concrete extending from a large door of the building near the furnace to a heavily reinforced slab on which the safes are dropped. The slab is covered with a layer of brick rip rap about 6 inches deep.

Fire Stream Test Apparatus. The apparatus used in the Fire Stream Test consists of a special movable hydrant, or flexible nozzle attached to the hydrant, a gate valve for controlling the stream, and a pressure gauge attached to the base of the nozzle.

The hydrant is connected to the mains below the floor of the building and is supplied by the pressure tanks and an electrically driven pump in the plant.

Apparatus for Testing Materials. The apparatus used for tests upon materials includes a 200,000-pound Riehle testing machine, a 10,000-pound Olsen testing machine, balances special gas furnaces, electric furnaces, calorimeters and chemical test apparatus.

SECTION II

UNDERWRITERS' LABORATORIES STANDARD METHODS OF EXAMINATIONS AND TESTS FOR SAFES AND INSULATED CABINETS

This section of the Standard treats of prescribed and standard examination and test procedures that are regularly employed by Underwriters' Laboratories to ascertain compliance with the standard of construction and performance under test given in Section III.

Plan of Investigation

Investigations of safes and insulated cabinets are made in accordance with the plan shown in the following outline, which indicates in the first column the separate phases or main divisions, in the second the various features involved in each phase, and in the third the titles of the tests and other means by which the information relative to each feature may be obtained. The procedure in the investigation of any individual type or pattern of safe or cabinet is to a considerable extent determined by its design and the character of materials used in its construction.

Information relative to any feature may be obtained from one or all of the sources indicated by the titles given in the third column of the outline mentioned, the extent of the investigation being largely determined by the results of the study of design and the character of the evidence obtained from the first tests and examinations.

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DESIGN AND CONSTRUCTION	**Form and Arrangement of Parts**	Study of Design, Tests of Materials, Installation Tests, Operation Tests, Fire Test, Impact Test, Fire Stream Test, Examinations at Factory.
	Suitability of Materials	Study of Design, Tests of Materials, Operation Tests, Fire Test, Impact Test, Examinations at Factory, Service Record.
	Workmanship	Study of Design, Tests of Materials, Installation Tests, Operation Tests, Fire Test: Impact Test, Examinations at Factory, Field Inspections, Service Record.
PRACTICABILITY	**Handling and Shipping**	Study of Design, Installation Tests, Examinations at Factory, Field Inspections.
	Installation	Study of Design, Installation Tests, Field Inspections.
	Operation	Study of Design, Operation Tests, Field Inspections, Service Record.
	Maintenance	Study of Design, Operation Tests, Service Record.
DURABILITY	**Wear and Tear**	Study of Design, Tests of Materials, Installation Tests, Operation Tests, Field Inspections, Service Record.
	Swelling	Study of Design, Tests of Materials, Service Record.
	Corrosion	Study of Design, Tests of Materials, Fire Test, Service Record.
STRENGTH	**Strength of Parts**	Study of Design, Tests of Materials, Installation Tests, Operation Tests, Fire Test, Impact Test, Fire Stream Test, Field Inspections, Service Record.
	Strength of Assembled Device	Study of Design, Installation Tests, Operation Tests, Fire Test, Impact Test, Fire Stream Test, Field Inspections, Service Record.
FIRE RETARDANT PROPERTIES	**Heat Insulation**	Study of Design, Tests of Materials, Fire Test, Impact Test, Fire Stream Test, Service Record.
	Stability	Study of Design, Tests of Materials, Fire Test, Impact Test, Fire Stream Test, Service Record.
UNIFORMITY	**Uniformity of Parts**	Study of Design, Tests of Materials, Installation Tests, Operation Tests, Fire Test, Impact Test, Examinations at Factory.
	Uniformity of Assembled Device	Study of Design, Installation Tests, Examinations at Factory, Service Record.

The methods employed in conducting the tests and investigations are described in the following:

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Appendix

Study of Design. The safes or cabinets furnished for test, and the drawings and specifications submitted by the manufacturer are studied to ascertain the form and arrangement of the parts.

The safes or cabinets and the materials submitted are examined as to condition, quality and appearance to ascertain so far as possible by such means, the suitability of the materials for the purposes intended and to ascertain the probable character of the workmanship necessary in the materials and in the safes or cabinets in which they are incorporated.

The safes or cabinets submitted are examined for injury and defects and the drawings and specifications and the instructions for handling and shipping, installation and maintenance are studied to obtain information relative to the practicability of the methods advocated for handling and shipping; to obtain information relative to the practicability of installing the safes and cabinets in the situations for which they are advocated with the class of workmen to whom this work is intrusted; and to obtain information relative to the practicability of repairing the safes or cabinets under the various conditions likely to be met with in practice.

The form and arrangement of the parts are studied and the known properties of the materials considered with reference to the ability of the safes and cabinets to withstand the various deteriorating influences and the stresses to which they are likely to be subjected under service conditions.

The drawings and specifications of the safes and cabinets are studied and the known properties of the materials considered with reference to the probable degree of heat insulation and stability of the safes and cabinets under the fire exposures to which they are likely to be subjected in the classes of buildings for which they are advocated.

The materials submitted and the drawings and specifications are studied to ascertain the probable degree of uniformity with which the materials and the safes or cabinets can be furnished commercially.

The results obtained from the study of design are compared with the standard requirements given in Section III.

Tests of Materials. The materials used in the construction of safes and cabinets are subjected to separate examination and tests to ascertain their physical and chemical characteristics when the Laboratories is not in possession of the necessary information relative to their suitability for the purpose intended. These examinations and tests are confined to those that will furnish data that are pertinent to the various features of the investigation.

The results obtained in the tests of the materials are compared with the standard requirements given in Section III.

Installation Tests. The safes or cabinets submitted for test are handled, unloaded, unpacked and examined as received to obtain information relative to the practicability of handling and shipping advocated by the manufacturer, as evidenced by the facilities and number of men required in handling and the condition of the containers and any injury or breakage in the safes or cabinets.

The safes or cabinets submitted for test are moved over the cement floors at the Laboratories and are installed on substantial level foundations to obtain information relative to the practicability of the methods of installation advocated and the strength and rigidity of the finished product as evidenced by the facilities required to handle the safes or cabinets, the ease with which they can be moved and transported over the floor, the probable precautions necessary for the protection of the safes and the various floors likely to be met with in the field against injury, and consideration of the various sizes and weights of the safes or cabinets submitted.

The safes or cabinets submitted for test are then measured and examined relative to the workmanship and uniformity as evidenced by the accuracy of the fits and clearances between the parts, the finish and the uniformity of the dimensions. Steel plates, $\frac{1}{4}$ inch in thickness are then placed under diagonally opposite casters of the safes or cabinet to obtain information relative to the strength and rigidity of the assembled parts, as evidenced by any distortions in the parts or changes in the fits and clearances.

The safes or cabinets are afterwards moved to and from the furnace used for the Fire and Impact Tests and observations made similar to those mentioned.

The results obtained in the Installation Tests are compared with the standard requirements given in Section III.

Operation Tests. After the safes or cabinets submitted for test have been installed on their foundations at the Laboratories, the locking mechanism doors and any movable interior equipment of each is repeatedly operated while the safes or cabinets are supported on level foundations and after the plates have been installed under the casters. These tests are made to obtain information relative to the practicability of operation, the moving parts under conditions that may exist in the field, as evidenced by the ease with which they can be operated and the freedom from binding due to racking or improper fits and clearances.

The safes or cabinets are examined to ascertain the extent to which the doors will open, the suitability of the form and arrangement of and the materials in the operating parts, the accuracy of the fits and clearances between the moving parts, the practicability of making repairs and renewals of the parts, the probable ability of the operating parts to withstand the wear and tear and the stresses to which they are likely to be subjected, and with reference to the uniformity of the operating parts.

The results obtained in the Operating Tests are compared with the standard requirements given in Section III.

Fire Test No. 1. A medium size safe or cabinet submitted for test is subjected to a quick, hot fire in which all exterior surfaces of the test sample are exposed to fire and heat.

The safe or cabinet is placed on raised incombustible foundations in the bottom of a special test hut, the fuel placed in position in the hut, the heat measuring apparatus installed in the hut and connected, and the fire started.

The fuel is of such a character and so arranged that the temperatures surrounding the test sample rise to at least 1000 degrees Fahr. in $2\frac{1}{2}$ minutes, 1300 degrees in 4 minutes, 1500 degrees in $7\frac{1}{2}$ minutes, 1600 degrees in 10 minutes and 1700 degrees in 15 minutes. The test is continued for at least 30 minutes. The fire is then extinguished and the test sample allowed to cool.

Observations are made during the test of the general character, distribution and temperature of the fire, and of anything indicating the disruption of the parts or explosion of the test samples.

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After the test sample has cooled to normal temperature, examinations are made covering any disruption of the parts or other indications of internal explosions, and covering its stability, as indicated by any bulging, buckling, warping, or separations.

Fire Test No. 2. The medium size safe or cabinet submitted for test is subjected to the standard fire conditions in which all exterior surfaces of the test sample are exposed to fire and heat.

The safe or cabinet is placed on the truck forming the bottom of the furnace, papers and records placed in the test sample, the heat measuring apparatus installed in the furnace and in the interior of the test sample adjusted and connected, the doors of the test sample and furnace closed and locked, and the fire started.

The gas and air supplies are adjusted so that the heat is well distributed throughout the combustion chamber and over the exposed faces of the test sample and so that the temperatures within the furnace rise to approximately 1550 degrees Fahrenheit during the first 30 minutes, to approximately 1700 degrees at 60 minutes, and gradually thereafter to the temperatures shown on the time temperature table given at the end of this chapter.

The test is continued until the highest of the temperatures indicated by the thermo-couples on the inside of the test sample reach 300 degrees. The fire is then extinguished and the test sample allowed to cool to normal temperatures without opening the furnace, the temperature in the interior being continuously recorded.

Observations are made throughout the test of the general character and distribution of the fire, the color of the parts of the test sample due to heat, the temperatures in the furnace and the temperatures in the interior of the test sample.

Observations are made throughout the test covering the heat insulation furnished, as evidenced by the temperatures recorded on the inside of the safe or cabinet and the time required for these temperatures to reach 300 degrees Fahrenheit; and also covering the stability of the safe or cabinet, as evidenced by any bulging, buckling or warping in or any sagging, separations, breakage or collapse of the parts, fusion or visible disintegration of the materials, or other evidence of insecurity or loss of strength.

After the safe or cabinet has cooled to normal temperatures, examinations are made covering its stability, as evidenced by any bulging, buckling, warping, or separations affecting the tightness of closure at the doors or between the parts; or by any breakage or bending of the parts or fusion or visible disintegration of the materials affecting the strength of or security of the fastenings between the parts.

The doors of the safe or cabinet are then forced open and examinations made covering the heat insulation, as evidenced by the legibility and usability of the records on the inside, the condition of the paint or enamel on the inside, and any other visible evidence of the transmission of heat; and also covering the stability of the safe or cabinet as evidenced by the security of the internal equipment, the locks, and the fastenings between the parts.

The safe or cabinet is then taken apart and examinations made covering the suitability of the form and arrangement of the parts for the purposes intended, the suitability of the materials and workmanship, the ability of the parts to resist corrosion, the strength of the parts and the assembled device, and the uniformity of the parts, as evidenced by the condition of the parts and the materials affecting the heat insulating properties and stability of the safe or cabinet.

The observations made during the period the safe or cabinet is exposed to fire, including all temperature readings, are regularly recorded at 5 minute intervals during the first hour and thereafter at intervals not exceeding 15 minutes.

The results obtained in the Fire Test are studied to ascertain compliance with the standard requirements given in Section III.

Table of Standard Furnace Temperatures

Time	*Temps.*	*Time*	*Temps.*
5 mins.	1000° F.	75 mins.	1750° F.
10 "	1300 "	90 "	1790 "
15 "	1400 "	105 "	1820 "
20 "	1460 "	120 "	1850 "
25 "	1510 "	135 "	1870 "
30 "	1550 "	150 "	1890 "
35 "	1580 "	165 "	1910 "
40 "	1610 "	180 "	1925 "
45 "	1640 "	195 "	1940 "
50 "	1660 "	210 "	1960 "
55 "	1680 "	225 "	1980 "
60 "	1700 "	240 "	2000 "

Impact Test. The large size safe submitted for test is subjected to the Standard Impact Test in which the safe is heated and dropped 30 feet in the clear on a rip rap of broken bricks.

The safe is first placed on the truck forming the bottom of the furnace, papers and records placed in the inside of the test sample, the heat measuring instruments installed in the furnace and connected, the doors of the test sample and furnace closed and locked and the fire started.

The test sample is exposed to the standard fire conditions for one hour, the observations during this period being the same as in the Fire Test except the temperatures in the interior of the safe are not measured. The furnace is then opened, the truck carrying the safe drawn out into the yard, and the safe immediately hoisted until the bottom is 30 feet above the rip rap of brick and dropped.

After the safe has cooled to normal temperatures, examinations are made covering its stability, as evidenced by any bulging, buckling, binding or separations affecting the tightness of closure at the doors or between the parts; or by any bending, breakage or collapse of the parts affecting the security of the fastenings between the parts or the strength of the assembled device.

The safe is then placed bottom upward on the truck, reinstalled in the test furnace and again subjected to the standard fire conditions for one hour, after which the safe is drawn from

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the furnace and allowed to cool to normal temperatures. The observations during the period the safe is exposed to fire are the same as in the Fire Test, except that the temperatures in the interior of the safe are not measured.

After the safe has cooled to normal temperature, examinations are again made covering its stability. The doors are then forced open and examination made covering the heat insulating properties, as evidenced by the legibility and usability of the records on the inside, the condition of the paint or enamel on the inside, and any other evidence of the transmission of heat; and also covering the stability of the safe as evidenced by the security of the internal equipment, the locks, the fastenings between the parts, and the condition of the parts.

The safe is then taken apart and examinations made similar to those at the end of the Fire Test.

The results obtained in the Impact Test are studied to ascertain compliance with the standard requirements given in Section III.

Fire Stream Test. When the results obtained in the Fire or Impact Tests are such as to indicate that the heat insulation or stability of the safe or insulated cabinet under investigation would be materially affected by the impact or contraction due to rapid cooling by fire streams, a medium size safe or cabinet is subjected to a Fire Stream Test in which the test sample is heated and then rapidly cooled by the application of a stream of water.

The safe or cabinet is exposed to standard fire conditions for at least one hour. The furnace is then opened, the truck carrying the test sample drawn out into the yard, and a 1⅛-inch stream of water immediately applied to the test sample for 5 minutes. The stream is directed against each of the sides from a distance of 30 feet, changes in the direction of the stream being made slowly. The pressure at the inlet to the nozzle is maintained at 50 pounds per square inch throughout the test.

The observations during the period the test sample is exposed to fire are the same as during the Fire Test, except that the temperatures on the inside of the test sample may not be measured.

Observations are made during and after the application of the stream covering the effect of the impact of the stream and the rapid cooling on the strength and stability of the safe, or cabinet as evidenced by bulging, buckling, warping, or bending of the parts, or breakage or lack of security in the fastenings between the parts.

The doors are then forced open and examinations made covering the effect of the stream on the heat insulating properties of the safe or cabinet, as evidenced by any separations at the doors or between the parts affecting the tightness of closure, or presence of water in the joints between the parts.

The results obtained in the Fire Stream Test are studied to ascertain compliance with the standard requirements given in Section III.

Examinations at Factory. The factory where the safes or insulated cabinets are manufactured is visited by Laboratories' engineers from the head office or nearest branch office for the purpose of obtaining general information regarding the manufacturer and the facilities provided for the manufacture of the safes or cabinets, and detailed information relating to those features of factory equipment and organization that have a bearing on the quality of materials employed, the character of the workmanship, the uniformity of the finished product, and the practicability of the methods of packing and shipping the finished product.

The materials are examined before and after the product is finished, to ascertain their uniformity and general suitability for the purposes for which they are intended.

The machinery and tools are inspected, the methods of manufacture studied, and the finished product examined to ascertain the accuracy with which the product is made and the degree of smoothness with which it is finished.

The facilities for checking the product for uniformity are examined in respect to their practicability and accuracy.

The method of packing the finished product for shipment is examined and studied with respect to its practicability.

The results obtained during the Examinations at the Factory are studied to ascertain compliance with the standard requirements given in Section III.

Field Inspections. If the safe or cabinet is being used commercially, inspections of actual installations in the field may be made by representatives of the Laboratories, preference being given to those installations most convenient to the main or branch offices.

These inspections include examinations to obtain information relative to the practicability of the methods employed in packing and shipping the safes or cabinets, as evidenced by their condition after they are received at the building; and examinations to obtain information relative to the practicability of installing the safes or cabinets, as evidenced by the facilities for such operations as hauling, handling, hoisting, transporting the safes or cabinets over the floors and installing them in position. The methods of installation advocated by the manufacturer are studied during these examinations.

The safes or cabinets are examined after installation with reference to the workmanship, as evidenced by the accuracy of the fits and clearances between the parts; with reference to the practicability of operating the moving parts, as evidenced by the ease with which these parts can be operated; and with reference to the strength and rigidity of the assembled parts, as evidenced by any binding between the moving parts due to distortions or changes in the fits and clearances.

When similar safes or cabinets have been in service in the buildings in which these inspections are made, investigation is made covering the character of service rendered during the period they have been in use. This investigation follows the procedure given under the title Service Record.

The results obtained during the Field Inspections are studied to ascertain compliance with the Standard requirements given in Section III.

Service Record. If the safe or cabinet has been used commercially for any considerable time, a list of purchasers is obtained from the manufacturer and letters sent to the users requesting information relative to the general suitability of the safe or cabinet for the purposes for which it was intended, and the character of the service it has given under the existing conditions.

Specific information is requested relative to the practicability of operating the movable parts; the practicability of making repairs or renewals; the ability of the safe or cabinet to withstand the wear and tear and deteriorating influences to which it has been subjected; its ability to withstand the stresses to which it has been subjected; and where several safes or

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cabinets have been used, the degree of uniformity in the results obtained in service.

In case the safe or cabinet has been exposed to fire, specific information is requested regarding the intensity and duration of the fire to which it was exposed, its effectiveness in preventing loss of the contents, and the character and extent of the damage to the safe or cabinet.

The information obtained as a result of the investigation of the Service Record is studied in connection with the results of the other tests and investigations to ascertain compliance with the standard requirements given in Section III.

Report and Inspection Service Specifications. At the conclusion of the tests and investigations the report to the Fire Council of the Laboratories or the submittor is prepared. When the safe or cabinet has been found to comply with the requirements of the standard of construction and performance under tests for one or more of the classes given in Section III, and the Fire Council has concurred in the recommendations in the report, detailed specifications are prepared for use by inspectors assigned to conduct examinations under the Label Service.

SECTION III

UNDERWRITERS' LABORATORIES' CLASSIFICATION OF SAFES AND INSULATED CABINETS

Safes and Insulated Cabinets are classified according to their fire retardant and impact resistive properties as follows:

CLASS A *Includes safes that are effective against severe fires for at least four hours, and fairly heavy impacts from falling or from falling bodies.*

CLASS B *Includes safes that are effective against severe fires for at least two hours, and fairly heavy impacts from falling or from falling bodies.*

CLASS C *Includes safes that are effective against severe fires for at least one hour, and fairly heavy impacts from falling or from falling bodies.*

INSULATED CABINETS *Includes cabinets that are effective against fires of moderate severity for at least 45 minutes, and that are not subject to impacts from falling or from falling bodies.*

Underwriters' Laboratories' Standard of Construction and Performance Under Tests for Safes and Insulated Cabinets

Safes and Insulated Cabinets complying with the following requirements are entitled to classification as standard in their respective classes.

Safes and Insulated Cabinets embodying forms of construction other than those indicated in this section are examined and tested under the standard and, if found to give equivalent results, receive recognition accordingly.

Design and Construction: (*a*) To embody insulated walls and doors, substantial hinges and locking mechanism, substantial casters, wheels or base and suitable internal equipment for the contents.

(*b*) The form and arrangement of the parts and the materials to be such that the parts and the assembled safes or cabinets will be practicable, durable, capable of safely withstanding the stresses and exposure to fire to which they are subject in the class of service for which they are advocated, and capable of being uniformly manufactured in commercial quantities.

(*c*) The parts to be formed, assembled and finished with the degree of accuracy, precision and uniformity necessary to furnish the requisite properties for safes or cabinets of good, reliable quality for the class of service for which they are advocated.

Practicability: (*a*) Safes or cabinets to be so designed and constructed that they can be handled, transported and installed, without serious injury, by the class of workmen to whom this work is ordinarily intrusted.

(*b*) Safes or cabinets to be so designed and constructed that the doors, locking mechanism and other movable parts can be reliably operated without undue effort by those to whom the operation of such devices is ordinarily intrusted.

(*c*) Safes or cabinets to be so designed and constructed that the doors, locking mechanism, interior equipment and other movable parts can be repaired or renewed, but not necessarily by those unskilled in such devices.

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Durability: (*a*) Safes or cabinets to be so designed and constructed that they will withstand without material deterioration for indefinitely long periods the wear and tear of ordinary use.

(*b*) Safes or cabinets to be so designed, constructed and protected that they will withstand without material deterioration for indefinitely long periods the inside and outside corrosive influences to which they are subject in the class of service for which they are advocated.

(*c*) Heat insulating materials used in safes or cabinets to be free from sweating or swelling and capable of retaining their heat insulating properties for indefinitely long periods.

Strength: (*a*) The parts and the assembled safe or cabinet to be sufficiently strong and rigid to withstand the stresses to which they are subject during handling, shipping and installation without material injury or the development of distortions or changes in the fits and clearances that will materially affect the strength of the assembled device or the reliability of operation of the movable parts.

(*b*) The parts and the assembled safe or cabinet to be sufficiently strong and rigid to withstand the stresses to which they are subject when the movable parts are repeatedly operated, without the development of distortions or changes in the fits and clearances that will materially affect the reliability of operation of the movable parts.

(*c*) The parts and the assembled safe or cabinet to be so designed and constructed that they will withstand the stresses occasioned by the Fire Test for the respective classes without bulging, buckling, warping, fusion, disintegration or other developments that will vitally affect the security of the locks and fastenings between the parts, or the strength of the parts or the assembled safe or cabinet.

(*d*) The parts and the assembled safe or cabinet to be so designed and constructed that they will withstand the stresses occasioned by the Fire Stream Test without bulging, buckling, warping or other developments that will vitally affect the security of the locks and fastenings between the parts, or the strength of the parts or the assembled safe or cabinet.

(*e*) The parts and the assembled safe to be so designed and constructed that they will withstand the stresses occasioned by the Impact Test without bending, distortions, displacements, ruptures or other developments that will vitally affect the security of the locks and fastenings between the parts, or the strength of the parts or the assembled safe.

Fire Retardant Properties: (*a*) The different classes of safes and the insulated cabinets to withstand the Standard Fire Test for the following periods before the highest indicated internal temperature reaches 300 degrees Fahrenheit, without destroying the legibility of the records stored on the inside, and without the development of separations or temperature effects on the inside or disintegration of the parts or materials that clearly indicate conditions likely to vitally affect the tightness of closure or the heat insulating properties of the safe or cabinet.

Class A Safes at least 4 hours,
Class B Safes at least 2 hours,
Class C Safes at least 1 hour,
Insulated Cabinets at least ¾ hour.

(*b*) All classes of safes to withstand the Standard Impact Test without destroying the usability of the records stored on the inside, and without the development of temperature effects on the inside, separations, distortions, displacements, ruptures or other developments that clearly indicate conditions likely to vitally affect the tightness of closure or the heat insulating properties of the safe.

(*c*) All classes of safes, and insulated cabinets, to be capable of withstanding the Standard Fire Stream Test without destroying the usability of the records stored on the inside, and without the development of temperature effects on the inside, or structural weakness that clearly indicate conditions likely to vitally affect the tightness of closure or the heat insulating properties of the safe or cabinet.

Uniformity: The parts and the finished safes or cabinets to be so designed that they can be made in commercial quantities with a sufficient degree of uniformity to prevent any material variation in their ease of operation, durability, strength, and fire retardant properties.

SECTION IV

GENERAL DESCRIPTION OF THE LABEL SERVICE PROCEDURE

This section of the Standard treats of features of the Label Service form of follow-up which, except for minor modifications, are common to all industries utilizing the Service.

Underwriters' Laboratories' Label Service as Applied Generally to All Industries

Purpose of the Label Service. The Labe Service is designed to provide a means whereby materials, classified as standard by the Laboratories as the result of examination and test of samples, are so constructed that the specified standards of quality and performance are maintained for product placed on the market and whereby such product may be readily identified by purchasers, property owners, inspection authorities and others interested.

Scope of the Label Service. The Label Service consists of:

(*a*) Factory Inspection Work:—Inspections of Products at factories and the labeling of standard product.

And in addition where practicable, of

(*b*) Field Follow-up Work:—Check tests on labeled product when reviewed where installed.

(*c*) Schedule Estimates:—Showing comparative demerits noted on labeled products.

Experience has shown that the Label Service is in every way superior for the purpose of

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bringing to the consumer the article he desires, for the purpose of placing competition between manufacturers beyond the point where deterioration in the quality of the output is made necessary, and for the proper protection of the Laboratories and the organizations co-operating with it which are giving substantial recognition to efficient fire protection and accident prevention appliances.

It has also been shown that an inspection and checking system of this nature can be efficiently operated under the Laboratories' direction without calling upon the manufacturer to give undue publicity to his manufacturing processes or subjecting him to embarrassment or annoyance.

Labeled products are not necessarily uniform in quality or merit. Labeling indicates only compliance with the Standards of the Laboratories for the product.

The Factory Inspection Work. The purpose of the Factory Inspection Work is to make examinations and tests at factories of material prepared for the market and to supervise the use of labels on the product.

Labels are applied at the factory by the manufacturer, to such of his output as conforms in all respects to the Standards of the Laboratories for the product, as shown by his own examination and tests, subject to the results of the examination and tests made by the inspector. The label thus serves as evidence of proper construction of the goods at the factory.

An inspector appointed by Underwriters' Laboratories visits the factory as often as occasion demands for the purpose of making examination of material prepared for shipment and making supplementary tests as outlined in the Standards of the Laboratories for the product.

Necessary Co-operation from Manufacturers in Factory Inspection Work. The low cost at which the Label Service is carried on makes it apparent that the fullest measure of co-operation is essential on the part of the manufacturer in instructing his employees to construct for labeling none other than duplicates of the standard sample. The Service is principally designed to serve as a formal check on the Supervision which the manufacturer exercises over the character and quality of his output. It is not designed to relieve the manufacturer of responsibility and cannot be utilized in cases where the desire for earnest co-operation is not manifest.

The Procedure in the Factory Inspection Work for the product covered by these Standards is given in Section V following.

Appeals on Standards and Conclusions Based Thereon

Courses of Appeal. Underwriters' Laboratories aims to secure the best and fairest opinion with respect to the merits of appliances, devices and materials submitted for its review and to have its work so carried on as to insure accuracy and uniformity in its findings. One of the measures adopted to assist in accomplishing these aims is the provision made for appeals from its findings by any client who may feel that the conclusions reached by the Laboratories as the result of either the original examination and test for listing, or the subsequent examinations and tests in the Inspection Service, or other methods of follow-up fail to give full recognition to the claims made for the appliance, device or material, in-so-far as these relate to the fire or accident hazard, or that the Standards, test methods or procedure are incorrect, or that the methods and practices in the conduct of the Service are lacking in efficiency, integrity or good faith.

National Bureau of Standards of the Department of Commerce. Where the question involved relates to the correctness of test methods and procedures and the conclusions based thereon, or has to do with similar features of the conduct of the technical work, an appeal may be taken to the National Bureau of Standards of the Department of Commerce at Washington, D. C. There exists a permanent arrangement between the Bureau of Standards and Underwriters' Laboratories whereby the Bureau consents to act on such appeals and whereby the Laboratories agrees in advance to accept the decision of the Bureau as to the correctness of its findings on these technical matters.

Industry Conferences. For a number of industries, conferences are established consisting of the proper members of the Laboratories Staff and representative committees of manufacturers to the end that full information as to examination and test methods may be transmitted to industries served by the Inspection Service and the views of the industry as a whole on such items be secured. The manufacturers' representatives on such industry conferences are usually nominated by the manufacturers through their associations, when such exist. Such a conference has referred to it by the Laboratories or by any individual manufacturer in the industry employing the Inspection Service, questions relating to the Standards under which the service is carried on, and exercises a general supervision over the Service for the industry it represents. The business of such a Conference is transacted by correspondence and by meetings held from time to time.

Appeals in Case of Disagreement. The practices and procedure in the conduct of the Inspection Service are defined for each individual industry in the Standards of the Laboratories for the product.

The agents of Underwriters' Laboratories at its several branch offices are authorized to pass as standard devices or materials found as the result of their inspections at factories to be in conformity with the requirements of the Standards and the description in the Laboratories record.

In case the manufacturer judges that authorization should be given for other standard goods examined, he should proceed as follows:

Appeal to Underwriters' Laboratories.

1. The manufacturer should immediately advise the Superintendent of the Label Service at the principal office of the Laboratories at Chicago (Preferably by telegraph). Promptly following the receipt of such advices, the Laboratories will send a Special Agent or one of its head office engineers to the manufacturer's plant to adjust the matter.

2. In case the Special Agent, head office engineer, or the Superintendent of Label Service is unable to satisfy the manufacturer in the matter of his complaint, the manufacturer should then lay the matter in writing before the President of the Laboratories.

3*a*. In case this does not bring a satisfactory adjustment, a further appeal may without delay, be made to the Board of Directors of the Laboratories, or as an alternative:

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Appeal to a Board of Arbitration. 3*b*. Where the question at issue does not involve changes in adopted Standards, but concerns the competency of officers, agents, or employees of either party, or the methods employed by them to the detriment of the other, as follows:

(*w*) Unnecessary delays or negligence.
1. By the Laboratories in making inspections.
2. By the Manufacturer in correcting admitted defects, or in providing and using suitable testing appliances.

(*x*) Lack of integrity or of good faith by either party.

(*y*) Ignorance by either party of Standards accepted by the Laboratories and the manufacturer.

(*z*) Prejudice or favoritism by either party.

It is optional with the manufacturer or with the Laboratories to elect in place of "3*a*" to have charges of the nature of those described above (not involving changes in adopted Standards) passed upon by a Board of Arbitration made up of three members, as follows:

One member to be chosen by the Manufacturer.

One member to be chosen by the Laboratories.

These two to choose the third.

The decision of this Board of Arbitration on the question of competency or conduct of the officers, agents or employees shall be final, the party against whom the decision is given shall pay the costs of the Board, and where lack of competency or improper conduct is shown, the servant or servants responsible therefor shall be reprimanded or discharged.

Whenever the finding is against Underwriters' Laboratories and Label Service has been suspended at the manufacturer's plant it shall be immediately resumed if desired by him.

Whenever the finding is against the manufacturer, Label Service will be resumed when the conditions which have been complained of are corrected by the manufacturer in a manner permitting proper operation of the service.

Appeal to Industry Conference. 3*c*. Questions of general interest to the industry as a whole and having to do with the Laboratories activities in the field of the industry may be brought for consideration to the Industry Conference. The Industry Conference is ready to serve as a Board of Arbitration on questions which may arise in the conduct of the Factory Inspection Work and either the manufacturer or the Laboratories may elect to refer questions at issue to the Conference rather than to a Board of Arbitration selected as previously described.

Label Service

Cost of the Label Service. The cost of the Label Service is defrayed by charges made for the labels. These charges vary according to the nature and extent of the inspection needed. For goods which can be tested by machinery or which are machine made and run through factories in such quantities that tests of a number of samples of each day's output give a fair criterion of the whole product, the charges run from fifty cents ($0.50) to one dollar and a half ($1.50) per thousand labels. For goods made by hand and goods which require inspection or test of each individual device, the charges run from seven and one-half cents ($0.07½) to fifty cents ($0.50) per label. In no case is the cost of the Service as represented by the charge for the label sufficient to become a factor of importance in determining the selling price of the article labeled.

The cost of labels for the product which is the subject of this Standard is as given in Section III following. The price charged for the labels covers the following costs:

1. The cost of making and handling the labels.
2. Time and carfares of inspectors at factories.
3. Proportionate part of the following costs:
   w. Special Agent Work.
   x. Home office supervision of conduct of Label Service.
   y. Countercheck testing and research work.
   z. Overhead charges.

Regular Service. The names of manufacturers regularly employing the Label Service in each separate industry are carried in the records of the Laboratories, and all such manufacturers are freely consulted in all matters concerning Standards of construction and inspection of the product of that industry.

In order that the Laboratories may maintain an efficient inspection and the requisite familiarity with the affairs of each industry it is necessary that they be assured a minimum amount from the yearly use of labels by each manufacturer.

The cost of the Label Service in each separate industry is based upon the expectation that the payments of each manufacturer included in the industry list will aggregate at least Thrity-six Dollars ($36.00) for each calendar year. If the amount paid for labels during a calendar year shall be less than Thirty-six Dollars ($36.00) the manufacturer is required to make up the difference between said Thirty-six Dollars ($36.00) and the sums already paid in during the year for such labels.

The minimum "Ready to Serve" charge of Thirty-six Dollars per year is calculated to cover participation in the Laboratories' dealings with the industry, and the cost of a necessary minimum number of inspections, where few, if any, labels are used.

Underwriters' Laboratories is for service, not profit, and charges for this Service only the actual cost thereof. Label prices are from time to time adjusted accordingly.

Limited Service. A manufacturer who does not care to participate in the Laboratories' dealings with an industry (including carrying his name in the records, consultation on Standard, etc.) and who anticipates using each year less than Thirty-six Dollars ($36.00) worth of labels, may obtain inspections of and labels for a single article or small lot of the article at such rates as will cover the Laboratories cost for the service rendered in each case.

The basis of charge for the Service shall be a function of the cost of such service under the specific conditions rendered within reasonable limits and shall be paid by the manufacturer within thirty (30) days after the rendering of bills for such service by the Laboratories. A reasonable basis of charge for Service is hereby defined to be as a rate of two dollars ($2.00) per hour per man, calculated according to the number of hours which in the judgment of the Laboratories were necessarily spent in the inspection work at the factory and in addition the time and other expenses of the inspector for traveling to and from the factory together with the cost of countercheck tests made at a testing station of the Laboratories, when such tests

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are called for in the Procedure. In addition the usual charge for labels will apply when labels are delivered.

Such Limited Service is, of course, available only after the manufacturer's device or material has been reviewed by the Laboratories and has been classified according to the same procedure and under the same Standards as apply to similar products under the Regular Service.

Serial Numbers on Labels. The serial numbers on the labels are for the purpose of countercheck by the Laboratories. A record is kept, by means of these numbers, of the manufacturer to whom they are issued, the date of issue and the approximate date of use. It is not required that manufacturers shall keep record of these serial numbers.

Use of Labels in the Order of Their Serial Numbers. Manufacturers are urged to use the labels in the consecutive order of their serial numbers so far as is possible.

Deliveries and Use of Labels. Stocks of labels are kept at each of the several Branch Offices of Underwriters' Laboratories. Labels will be delivered from these stocks to factories located within the territory of the Branch Office promptly following receipt of order stating the number of labels desired. Payment for labels is to be in advance in all cases, and orders for labels should be accompanied by remittances drawn payable to UNDERWRITERS' LABORATORIES.

Labels will be supplied from the nearest office of the Underwriters' Laboratories, which in the case of the manufacturer indicated on the front page of these Standards, is .....

In order that proper supervision of the use of labels may be had by Underwriters' Laboratories through its authorized inspector, it is required that labels be applied to products only *in the factory* in which the products are made and *before shipment* from the factory. The cost of the Label Service (covered by the price charged for the labels) does not anticipate supervision of he labeling of the product at other than the factory (*i.e.*, not in manufacturer's, jobber's or dealers' warehouses, etc.) and labels so used will not be recognized and when found will be cancelled and inspection authorities and others so notified. Similarly, deliveries of labels by one factory to another whether under common management or not, will result in special conditions being established with regard to future use of labels in either plant.

Use of Name of Underwriters' Laboratories. Manufacturers shall not make use of the name of the Laboratories or an abbreviation, symbol or any equivalent thereof (other than that which appears on the Label itself) on products provided, however, that subject to the approval of the Laboratories as to wording and method of attachment the manufacturer may refer, on the package, carton or other container in which the product bearing the inspection label is packed for shipment or sale to the fact that the original contents of the package, carton or other container bears the Laboratories' inspection label.

The label is evidence of inspection at the factory in which the products are made. We do not permit subscribers to furnish labels for attachment in the field either by themselves or by their customers. Violation of the foregoing rules will result in suspension of label service and the institution of special conditions regarding their future use.

SECTION V

PROCEDURE FOR INSPECTION AT FACTORIES AND THE USE OF LABELS ON SAFES (CLASS)

Labels for Safes (Class)

Design:—The labels for CLASS SAFES are of etched brass and are $\frac{3}{8}$-in. wide by $3\frac{1}{4}$ inches long. They are of the general appearance and design as shown below

Underwriters' Laboratories INSPECTED SAFE Class____ No.____

Labels as issued are serially numbered. The labels are furnished in packages of 100 labels each and are provided with two 1-16 in. holes for attaching, holes being spaced 3-1-16 in. on centers.

Application of Labels:—The labels are secured to the device by at least two rivets or screws with heads headed over after attaching, where they will be visible. One label is used for each safe, and they are applied by the manufacturer to such of his product as is judged to conform to the foregoing specifications.

Price Charged for Labels:—The price of labels for SAFES CLASS is now $50.00 per 100 labels.

Privileges of Inspectors. The inspector shall have free access, during hours in which the factory is in operation, to the test room, assigned to his use, and to store or shipping rooms for finished labeled products. It will be his privilege to inspect and subject to prescribed examinations and tests, prior to shipment, any or all product which is labeled or which is intended to be labeled; and the manufacturers must grant to him all necessary rights and privileges and provide all necessary appliances and assistance for such purpose.

General Instructions to Inspectors

Conduct at Factory. The inspector shall refrain from conversing with any employee of the manufacturer other than the person or persons designated by the manufacturer to receive his comments. The inspector will avoid entering any portion of the factory where

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the necessities of his work do not require his presence.

Correspondence. Copies of all letters from the manufacturer to the Inspector must be promptly forwarded to the Laboratories.

Labels. The inspector shall see that the use of labels is confined to product complying with the Specifications of the Standards and with the Description of the product of the manufacturer. The inspector is not authorized to allow labels to be used on any product not covered by the Description, except as the result of special advice to him and to the manufacturer from the Chicago testing station of the Laboratories.

Duties of Inspectors. The inspector's principal duty is to satisfy himself that all products shipped from the factory with the label attached, conforms in all essentials with the Specifications of the Standards and with the Description for the product of the manufacturer. It will usually be the case that the manufacturer's program of production, inspection, test and shipping is well known to the inspector, and may be regarded as largely assuring uniformity of output from day to day. Hence, under normal conditions the inspector's work will be that of counter checking, the product already passed by the manufacturer as suitable for labeling. When and while these conditions do not obtain, the inspector may be advised by the Superintendent of Label Service as to the special procedure to be followed.

Inspectors' Reports

General. The inspector will report on form on yellow paper, like sample following, the results of examinations and tests made by him at each factory inspection. Under normal conditions copies of this report will not be furnished to the manufacturer by the inspector. It shall be understood, however, that test results shall become a part of the manufacturer's permanent test record.

A report must be made out for each inspection as soon as possible after a visit to the factory and be promptly forwarded to the Chicago Office for review.

The inspector will clearly indicate in reports all sub-standard features developed in the examination or tests. Criticisms or suggestions made by the inspector to the manufacturer shall be in writing and if given orally shall be confirmed *at once* in writing in all cases. For all such confirmations form L.S. Genl. 1 on pink paper like the sample following shall be employed.

Filling in Report Forms

First Page of Report Form. Fill in completely as indicated.

"Ref. No." refers to the Laboratories classification (the letters E., R., Ex., MH., etc., are used to denote "Electrical," "Retardant," "Extinguisher," "Miscellaneous Hazard," etc., under which the product is listed by the Laboratories and to the file number of the Laboratories record on the construction and tests of the original samples.

"Serial No." refers to the number of the inspection or report in the numerical order of the inspections and reports which have been made at this factory during a given year on the product covered by these Standards.

Always fill in the date on which the inspection was made and give the name and address of the manufacturer in full.

Under "Criticisms" give a summary (in the form of a carbon copy of the "notice of defects" letter to the manufacturer) of the sub-standard features, including, if any, failures in tests noted in the detailed examinations and tests in the inspection being reported upon. These features are to be noted also under the individual headings on the other pages of the report form.

Fill in blank spaces under this heading as indicated.

All criticisms must be reported immediately and in writing to the factory management, using the special pink paper form, L.S. Genl. 1 or "Notice of Defects" provided for the purpose. When using this form the inspector shall arrange that a carbon copy of the advices given thereon shall be made on the regular report form under the heading "Criticisms." The spacings on the form are arranged so that this may be done readily.

Under "Summary of Tests and Failures" the inspector shall give the number of tests made and the number of failures obtained in the inspection being reported upon.

Under "Labels" give the information called for. The serial number of the labels are to be given also under the individual headings on the other pages of the report form.

Under "General Remarks and Recommendations" the inspector may advise as to his general impressions of the progress of the inspection work at this factory and any items of general interest. When criticisms are made, he should briefly state whatever suggestions or recommendations he may have as to the way the situation should be handled, supplementing the same usually by letter or telegram. If he has, himself, taken any action the report should so indicate. The inspector should advise briefly of improvements mad in features criticised in this or previous reports and of general improvements in the workmanship of the material and in the arrangement and character of test apparatus, etc.

"Signature":—The report should be signed by the inspector making the inspection and the name of the branch office at which he is stationed should be given together with the time and carfare charged for the inspection.

Other Pages of the Report Form. The inspector shall fill in the form as indicated with the data secured as a result of examinations and tests upon product reviewed by him on the date of the inspection being reported upon.

Inspectors must always fill in forms with all of the information asked for if it has been obtained. A dash or blank in report form is understood to indicate that the inspector has no information to furnish on the point in question. When possible, answer briefly by "Yes" or "No" or "O.K." or by the figures or other data called for.

The information given by the inspector on the report form should usually be only that obtained on the date of the report and usually only that obtained as a result of examination of the devices being reported upon. In some instances it is desirable, however, that stocks of materials held by the manufacturer and intended for use in the construction of labeled devices shall be gone over, especially as new supplies are received. If the information given is the result of observation of stocks of materials not yet assembled the inspector should make a statement to that effect on the report form.

Sub-standard features are to be noted also on the first page of the report form under "Criticisms."

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Form L. S. Gen'l 3 sold out

Report from Branch Office in

City_____

By_____
(Signature of Inspector)

Date of Insp. | Ref. No. | Ser. No. of Rep.

Charges For This Inspection

	ITEMS		TOTALS	
Postage on Samples				
Hotel (Out of Town)				
Car Fare				
Time	Hrs			
		Total		

Labels

Serial Nos. of labels used since last previous inspection

Denom	From	To	Total

Are labels used in order of Ser. Nos.?____

Ser. Nos. of labels removed from rejected product?_____

Die Label of form and size specified?____

Was it located as specified?_____

Was wording legible?_____

Summary of Tests and Failures

DETAIL	No. of Samples Inspected	No. of Samples Substandard

Samples to Chicago Office

How Shipped { ____ Exp. / Parcel Post } { Prepaid / Collect }

Date on which last previous samples were selected?_____

INSULATED CABINETS (72)
LIGHT WEIGHT SAFE

Manufacturer Name of .....

Factory Location of .....

UNDERWRITERS' LABORATORIES

POSTING CHECK

FACTORY INSPECTION REPORT

LABEL SERVICE WORK

EXAMINER'S CHECK

Criticisms. Were all the details marked on the other pages of this report, checked by you on product inspected on this date?_____ Were substandard features noted in any samples?_____

To whom were the criticisms orally reported?_____

Was the oral report confirmed on "defect notices" to manufacturer?_____
(A carbon copy of the summary of substandard features as listed on the "defect notice" should be given herewith.)

General Remarks and Recommendations Were substandard features corrected on all samples?_____ Or were labels removed?_____ If not, explain action taken.
Use telegraph whenever there is urgent need for prompt action by the Chicago Office.)

SUMMARY POSTING CHECK

First page of Factory Inspection Report

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Form 72

INSULATED CABINET LIGHT WEIGHT SAFE

	Ins. Cab.	Light Weight Safes		
		A	B	C
SIZES				
Were the sizes examined within the limits specified? width				
depth				
height				
area of walls				
length of door joints				
MECHANICAL CONSTRUCTION				
Thickness of sheet steel? (Thousandth inches) outer shell				
inner shell				
doors				
Are sections formed as specified? outer shell				
inner shell				
doors				
Are sections reinforced as specified? outer shell				
inner shell				
doors				
Are jambs, sill, and lintel sections form and dimen. spec.?				
Are stile and rail sections of doors of form and dimen. spec.?				
Are these sections reinforced as spec. at holes for latch bars?				
Are all sections secured to each other as spec.?. outer shell				
inner shell				
doors				
Is inner shell secured to outer shell as specified?				
Are walls of body of the thickness specified? back				
sides				
top				
bottom				
Are walls of doors of the thickness specified?				
Are caps, if any, formed as specified?				
Are caps, and moldings, if any, secured as specified?				
Are doors supplied in pairs as specified?				
Are special features, if any, provided as specified? (See supplementary sheet)				
HEAT INSULATION				
Is composition of the insulation as specified?				
Is the thickness of the insulation as specified? sides				
top				
bottom				
back				
doors				
Is the insulation free from excess moisture?				
Is the insulation secured in place as specified? sides				
top				
bottom				
back				
doors				

Second page of Factory Inspection Report

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	Ins. Cab.	Light Weight Safes		
		A	B	C
Is the insulation reinforced as specified? { body				
Is the insulation free from objectionable defects? { doors				
Is the insulation of the walls as complete as required? { body				
Are the joints between sections of insulation made tight and as specified? { doors				
HARDWARE				
Hinges				
Are these of the material specified?				
Are they of the form and dimensions specified?				
Are they spaced as specified?				
Are they secured to body and doors as specified?				
Latching Mechanism				
Are the latch bars of the form and dimen. spec.?				
Is operating mech. for single doors of form and dimen. spec.?				
Is operating mech. for "standing" doors of form and dimen. spec.?				
Is operating mech. for "swinging" doors of form and dimen. spec.?				
Are latching mech. secured to doors as spec.?				
Do latch bars project at least ½-inch from door edges?				
Locks				
Are combination and key locks, when used of design spec.?				
Are they secured to doors as specified?				
Casters				
Are these of the material specified?				
Are they of the form and dimensions spec.?				
Are they spaced as specified?				
Are they secured to body as specified?				
FINISH				
How is metal protected against corrosion?				
INTERIOR FITTINGS				
Are supports for shelving, partitions, etc., when provided made and attached to inner shell as specified?				
WORKMANSHIP				
Comment on workmanship as shown by:				
Completeness of insulation of shells				
Fit of sections of inner shell				
Effectiveness of riveting and welding operations				
Ease of operation of latching mechanism				
Fit of latch bars in catches				
Fit of doors with body on face and at rabbets				
MARKINGS				
Is each finished cabinet and safe marked with the name or trade mark of the manufacturer?				

Third page of Factory Inspection Report

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W H MERRILL, President
W C ROBINSON
DANA PIERCE
A R SMALL
Vice Presidents.
D B ANDERSON, Secretary.
L B HEADEN, Treasurer

CHICAGO, 207 E. OHIO ST.
NEW YORK, 25 CITY HALL PLACE
BOSTON, 87 MILK ST.
PITTSBURGH, 324 FOURTH AVE.
AGENCIES IN ALL PRINCIPAL CITIES OF THE UNITED STATES AND CANADA

Underwriters' Laboratories

INCORPORATED 1901
ESTABLISHED AND MAINTAINED BY THE
National Board of Fire Underwriters
FOR SERVICE - NOT PROFIT

207 EAST OHIO STREET, CHICAGO

LABEL SERVICE WORK

NOTICE OF DEFECTS

FACTORY INSPECTION

Date_____ 19____ **Ref. No.**_____ **Serial No.**_____
(When inspection was made) (Of this report)

Manufacturer_____
Name of

Factory_____
Location of

Attention of:

_____ 19____
(Date of Notice)

_____
(Name of Officer and Title)

Gentlemen:

Inspection at your factory on above date developed sub-standard features in product submitted for labeling as noted below.

Copy of this letter has been forwarded to Chicago Office on inspection report of above serial number.

This confirms oral advices given to Mr._____

UNDERWRITERS' LABORATORIES

From Branch Office in_____ by_____
(City) (Name of Inspector)

Official notice of sub-standard features

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Procedure in Factory Inspection Work

Definitions. *Specifications.* The term "Specifications" as used in this Procedure refers to the Specifications given in Section I (of the Procedure for each manufacturer).

Standard Sample. The term "Standard Sample" or "Description" as used in this Procedure refers to a duplicate of the sample of the manufacturer's product which was tested by Underwriters' Laboratories, and which forms the basis upon which the product of the manufacturer is listed by the Laboratories as being in compliance with the Specifications for the product.

The standard Sample, when one is used, is in duplicate; one sample being filed at the Chicago Office of the Laboratories and the other filed with the Branch Office assigned to conduct the Factory Inspection Work on the product.

Scope of Factory Inspection Work. The Factory Inspection Work consists of checking essential features of construction and design of representative samples, with a duplicate of the original sample tested. It includes:—examinations of materials used and of workmanship; measurement of dimensions of materials; checking of form and arrangement of parts; operating tests of finished product, etc.

Under usual conditions every detail of the Description or Standard Sample shall be checked by the inspector at each inspection. It will not usually be practical, however, nor should it be necessary for the inspector to check each device in all of the particulars given in the Description and Specifications or shown by the Standard Sample. For example, one device may be examined in certain details, another in others, etc.

If any deficiencies are found, it will be necessary for the inspector to either reject the whole lot, or to subject each device to a complete examination and reject those devices which are deficient for labeling. The course to pursue in such cases will usually be indicated by the circumstances. The inspector shall require that each device be made standard if it is to retain the label and he should watch carefully for a recurrence of a like deficiency in devices made subsequently until the product appears to be again normal.

The following detailed procedure for conducting the Factory Inspection Work together with the following requirements for performance of the product under examinations and the following details of construction shall apply.

Examination and Test Methods. The following is to be regarded as instructions covering the application of the specifications to this Factory Inspection Work. The Specifications are supplemented in the following by additional matter to be regarded as instructions covering the application of the Specifications to this Factory Inspection Work.

Second and Succeeding Pages. The Laboratories inspector will not accept for labeling, fire-resisting storage receptacles of other classifications than those given in the Specifications *i.e.*, if only receptacles of the Insulated Cabinet classification are described in the Specifications, the inspector will not permit the labeling of receptacles of the Light Weight Safe classification.

The Laboratories inspector will not combine on one form, a report covering inspections of both Insulated Cabinets and Light Weight Safes but will render two reports using a separate form for fire-resisting storage receptacles of each classification.

Sizes. Storage receptacles of sizes exceeding the limitations given in the Specifications are not to be accepted for labeling. It should be noted that the sizes are limited in four ways: inside width, inside depth, inside height, area of inside walls, and length of door joints on inside of cabinet or safe (*i.e.* perimeters of doors, including perimeters of both doors when doors in pairs are used, the joint between doors in pairs to be measured but once).

Mechanical Construction. The inspector will not accept for labeling, storage receptacles having any sections, outer shells, inner shells or doors made of sheet steel of lesser nominal thicknesses than those given in the Specifications. Metal nominally of the following U. S. gauges should measure:—

U. S. Gauge No.	*Nominal Thickness—inches*
24	0.025
22	0.03125
20	0.0375
18	0.050
16	0.0625
14	0.078

To allow for mill variations, stock not less than the following:—

U. S. Gauge No.	*Minimum Thickness—inches*
24	0.0235
22	0.0295
20	0.0355
18	0.0475
16	0.0595
14	0.0740

may be used in the construction of storage receptacles but the inspector should not be expected to accept a lot of storage receptacles made from stock all of which is of this minimum thickness since the usual mill run of this material should average up to gauge. The thickness of a sheet of metal is to be taken as the average of at least five measurements across the width of the piece. Decreases in thickness due to the drawing of the metal in presses or brakes may be disregarded. Measurements for thickness of sheet shall be made with round-nosed micrometer calipers reading directly in thousandth inches.

The inspector will not accept for labeling, storage receptacles having any sections of the body (including joints, sill and lintel sections) or doors (including stile and rail sections) formed of materials or of a design other than is given in the Specifications.

The inspector will accept for labeling only such storage receptacles as have all sections of inner shells and doors reinforced to stiffen the sections and to provide for attachment of hardware as required in the Specifications. The reinforcements must be secured in place as specified.

The inspector will not accept for labeling storage receptacles, having joints, sill and lintel sections of body, and stile and rail sections of doors reinforced for latch bars in a manner other than is given in the Specifications.

The inspector will not accept for labeling, storage receptacles having the several sections of the outer shell, inner shell or doors secured to each other in a manner other than is given in the Specifications.

The inspector will not accept for labeling, storage receptacles having inner shells of body secured to outer shells in a manner other than is given in the Specifications.

The inspector will not accept for labeling, storage receptacles having bodies or doors with

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any wall of a thickness other than is given in the Specifications. The thickness of a wall is the distance between the inner and outer faces. This thickness shall be measured with a steel scale graduated to read directly to 1-16 inch.

Caps or crowns and mouldings, if provided, must be formed and attached to bodies as required in the Specifications.

The inspector will not accept for labeling storage receptacles having single doors mounted on bodies having an inside width greater than the specifications permit to be equipped with a single door.

The inspector will accept for labeling only such storage receptacles as have bodies provided with the special features required in the Specifications.

Heat Insulation. The inspector will not accept for labeling, storage receptacles having walls of bodies or doors insulated with heat-insulating materials other than those given in the Specifications.

The inspector will not accept for labeling, storage receptacles having walls of bodies or doors insulated with other thicknesses of the heat insulating materials than those given in the Specifications. Thicknesses shall be measured with a steel scale graduated to read directly to 1-64 inch.

The inspector will not accept for labeling, storage receptacles having heat-insulating materials disposed within any walls of the bodies or doors in a manner other than is given in the Specifications.

Storage receptacles employing block insulation must not contain more than one (1) broken block in every five (5). All broken blocks used to be carefully cemented together under pressure. Pressure to be maintained until cement is dry. It is preferred that the joint is held by wiring or staples in addition to the cement. No two (2) broken cemented blocks in any wall of the safe to be adjacent.

The inspector will not accept for labeling, storage receptacles in which the heat-insulating materials are held in place in a manner other than that given in the Specifications.

At quarterly intervals, or oftener, when requested by the Laboratories, the inspector will forward samples of all types of insulating material used in Standard safes for analysis and check tests, to see that materials used is the same as that originally submitted.

Hardware. *Hinges.* The inspector will not accept for labeling, storage receptacles equipped with hinges (including hinge pins) made of materials or of a design other than is given in the Specifications.

The inspector will not accept for labeling, storage receptacles having doors mounted to bodies with a lesser number of hinges than is required in the Specifications, or with top and bottom hinges located a greater distance from the ends of the outside face of the door than is specified.

The inspector will not accept for labeling, storage receptacles equipped with hinges which are secured to bodies or doors in a manner other than that given in the Specifications.

Bolting Mechanism. The inspector will not accept for labeling, storage receptacles having doors equipped with bolt bars made of materials or of a design other than that given in the Specifications.

The inspector will not accept for labeling, storage receptacles having doors equipped with bolt bars operated by a mechanism made of materials or of a design other than that given in the Specifications. This will require that the number of bolt bars and their disposition with respect to the door edges will be as given in the Specifications.

The inspector will not accept for labeling, storage receptacles having doors equipped with bolt bars secured to operating mechanisms or with operating mechanisms secured to doors in a manner other than that given in the Specifications.

The inspector will not accept for labeling, storage receptacles having doors equipped with bolt bars which project less than ¾-inch when the bolt bars are thrown as far as the operating mechanism will permit.

Locks. Combination or key locks, if supplied, must be in addition to the latching mechanisms and should be of the design and be attached to doors as given in the Specifications.

Casters. The inspector will not accept for labeling, storage eceptacles having bodies equipped with casters made of materials or of a design other than that given in the Specifications.

The inspector will not accept for labeling, storage receptacles having bodies equipped with a lesser number of casters than is required by the Specifications.

Finish. The metal parts on the interior and exterior of storage receptacles must be painted or enameled.

Interior Fittings. Supports for shelving, partitions, etc., if supplied, must be made and secured to interiors of storage receptacles as specified.

Workmanship Great care must be taken to see that all joints at edges of slabs or layers of heat insulating material are tight.

The fit between several sections of the inner shell must be snug and the crack, if any, between the sections uniformly narrow.

All riveting and welding operations must be effectively and properly done.

The latches must operate readily without binding when the doors are in closed position.

It should not be possible to rattle the doors when they are in closed position and the doors latched.

The gap between the outside front face of the body and the outside front faces of the doors and at meeting edges of doors in pairs should be uniformly narrow. Width of gap between doors will usually average about 1-16-inch but should not be greater than 3-32-inch at top and sides nor more than ¼-inch at bottom.

The metal of the tops of the tongues and bottoms of the grooves of the doors should come as nearly in contact with the bottom of the grooves and the tops of the tongues respectively of the body as is practical. The bottoms of the grooves may be filled with asbestos strips glued in place for the full lengths of the grooves when necessary to accomplish this result. The width of the gap between tongues and grooves should be such that it will not be possible to draw a strip of cotton duck 1-32-inch thick through the door crack nor to readily draw a strip of cotton duck 1-64-inch thick through the crack when the doors are closed.

Markings. Each storage receptacle must be marked with the name or trade-mark of the manufacturer.

Labels. The inspector will see that the labels of a given class (*i.e.* Insulated Cabinet or Safes) are used only on material given that classification in the Specifications.

Manufacturers are urged to use the labels in the consecutive order of their serial numbers so far as is possible, and the inspector shall call attention to a failure to follow practice.

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